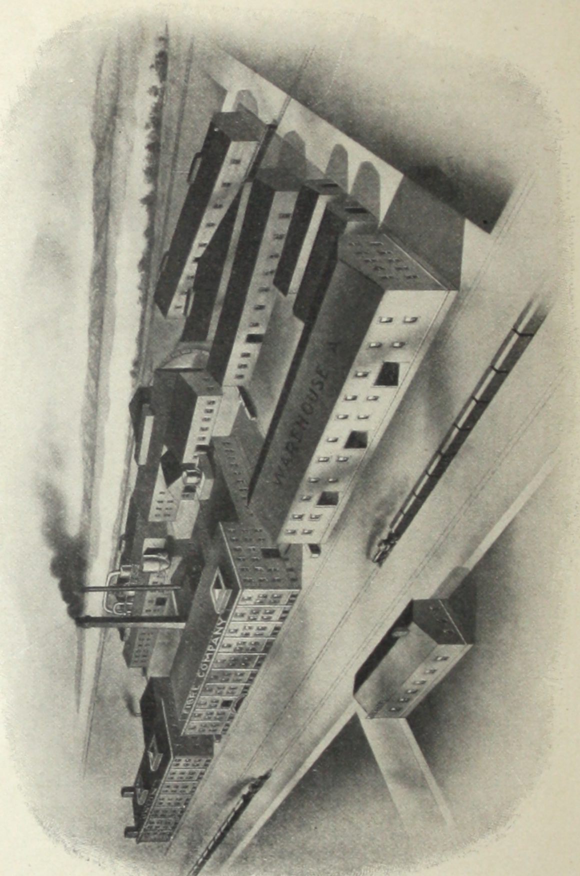
INSULATION FOR COLD TEMPERATURES

UNION FIBRE CO.

WATERPROOF LITH
UNION CORK BOARD
LINOFELT
FIBROFELT

MAIN OFFICE: WINONA, MINNESOTA

SALES OFFICE
650 RAILWAY EXCHANGE BLDG.. CHICAGO, ILL.


WAREHOUSE A
COMPANY

INSULATION

for

COLD TEMPERATURES

A Description of the Insulating Materials made by the Union Fibre Company for excluding Heat from Cold Storage Warehouses, Breweries, Ice Plants, Fish Freezers, Creameries, Fur Storage Vaults, Refrigerators of every type, and all rooms in which cold temperatures are maintained.

UNION FIBRE COMPANY

Main Office and Factory
WINONA, MINNESOTA

Factory
YORKTOWN, INDIANA

CHICAGO, ILLINOIS, 650 Railway Exchange Building

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CHAPTER I.

GOOD INSULATION IS A NECESSITY IN MAINTAINING COLD TEMPERATURES

Cold Rooms for Perishable Products

The influence of cold temperatures in preventing or retarding the development of decay germs on food products has led in the United States to a splendid development of the science of refrigeration and to the building of many structures in which are stored meats, butter, milk, and all sorts of perishable products for reasonably long periods of time. Steel plants as well as bakeries and many other industrial establishments need rooms or compartments which can be kept cold—some even below the freezing point—no matter how warm the weather may be outside the building.

To produce these cold temperatures the science of refrigeration has developed an ice machine, which introduces into the room in which the perishable goods are stored a very cold liquid or gas contained in iron pipes. Since heat, whether in meat or in butter or in any other substance flows from a high temperature to a lower temperature the cold pipes which are situated close by take up and carry off the heat

given up by the goods and thus the temperature of any material whatsoever, may be reduced.

Ice used for cooling acts in a similar way; the heat of the goods flows towards the ice which is melted and the melted ice or water carrying the heat is led away from the room by drains.

If it were possible to build a room into which no outside heat would enter, the cooling pipes or the ice would have very easy work to extract from the perishable goods the heat contained in them. Only a small amount of ice or a few pipes would be needed.

Heat entering Cold Rooms through Walls, Floors and Roofs

It is found in practice, however, that the refrigerating-device has two large duties, the first is to carry off the heat of the goods to be cooled, the second is to carry off the heat which comes through the walls, roof and floor of the room from the great external source of all heat—the sun. The amount of heat which enters even into a well constructed cold room is enormous. More than eighty per cent of the cooling machinery is taken up entirely with removing the heat which comes from the outside through walls, roof and floor, and only twenty per cent is expended for the actual purposes of the business, that is, to cool the stored goods.

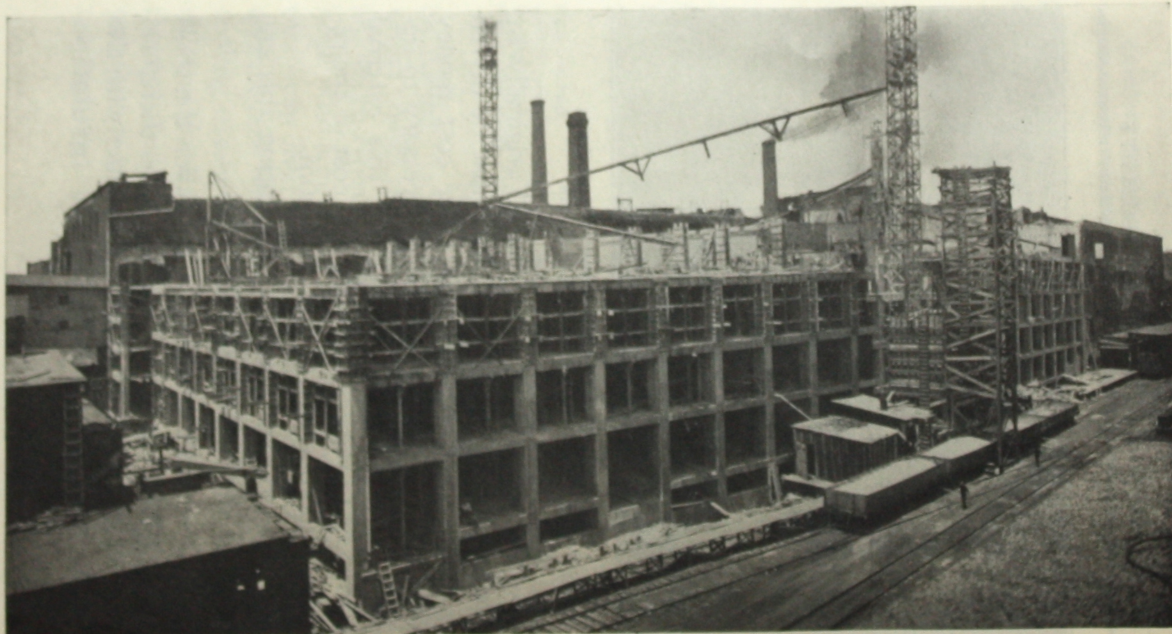
Big Four Ice & Cold Storage Company, Waco, Texas
Insulated by Union Fibre Company

Refrigeration must be produced originally by a power plant; the ice machine must be driven by steam or electricity and these cost money every day. Hence it has been necessary to devise some means of cutting out this external heat so as to reduce the duty and cost of the refrigerating machine to the minimum.

The modern means of preventing this entrance of heat is called insulation.

Insulation Deserves Serious Consideration

In designing a room for the cooling of perishable goods, therefore, the owner should consider with the utmost seriousness the kind of insulation



Morris & Company, Chicago, Ill.
One of the six largest coolers in the world — insulated with Waterproof Lith

Western Packing & Provision Co., Chicago, Ill.
Insulated by Union Fibre Company

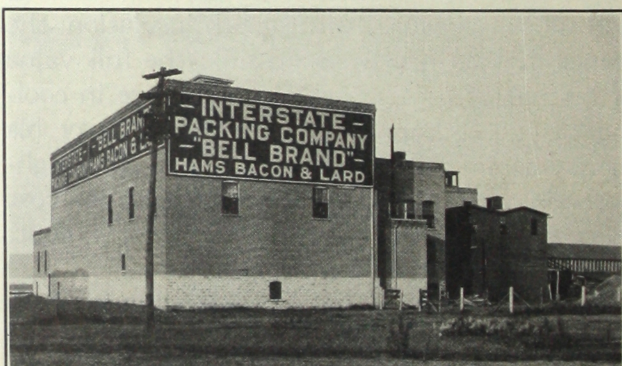
material to be placed on the walls, ceiling, and floor, because with good insulation the owner gets as nearly as possible the full value of his refrigerating machines or his ice in cooling his goods, and does not throw away his money cooling the air and ground in the neighborhood of his plant. Ice and refrigeration cost money continually every day and every hour, but good insulation costs only once.

Builders of refrigerating machinery particularly voice the wisdom of using the best insulation. They know that their machines cannot make a fair record or satisfy the buyer if in addition to the legitimate and estimated task

of refrigeration, they must struggle with unreasonable quantities of heat stealing in every minute and every hour through poor insulation.

Economies Effected by Good Insulation

Good insulation results in economies so vast that if the facts are brought home to him, no reasonable man will hesitate to use it; it permits economies everywhere; a smaller refrigerating machine will do the work; less piping is required; in case of accident to the machines, superior insulation will hold the temperatures until repairs can be made, and, by saving valuable stores from injury, may in a single emergency repay entirely its first cost.



INTERSTATE PACKING CO., WINONA, MINN.
Where Water-proof Lith insulation saved from loss a storage building filled with meats

P. A. JACOBSON, PRES. AND GEN. MGR.
C. A. BOALT, V.-PRES.

CODES { CROSS
ROBINSON

A. J. SCHUMACHER, SECY.-TREAS.
G. J. ROHWEDER, ASST. MGR.

INTERSTATE PACKING COMPANY

PORK PACKERS AND JOBBERS OF

PROVISIONS

SAUSAGE MANUFACTURERS

MAIN OFFICE
AND PACKING PLANT
WINONA, MINN.

BRANCH HOUSES
MINNEAPOLIS, MINN.
DULUTH, MINN.

WINONA, MINN., Aug. 29, 1907.

Union Fibre Co.,

Winona, Minn.

Gentlemen:-

We have your letter of August 17 asking about our experience during the cyclone which struck Winona on August 6 and shut off the refrigeration in our plant, so that we were forced to rely on the insulation alone to hold the temperatures in our cooling rooms. Briefly the facts are as follows:

On August 6 at 5:00 P.M. our condensor was blown off the roof of our building and practically our entire charge of ammonia escaped. Instructions were issued at once to keep all cooler doors closed until the plant was repaired. We then went to work to repair the damage and Thursday morning, August 8, at 2:30 A.M. we had our plant in shape where we could start it.

When we atarted, I went into our cooling rooms and found in that time, 33 1/2 hours, the thermometer had raised from 38 degrees F. (the temperature before the accident) to 40 degrees F., a variation of only 2 degrees.

We consider this about as severe a test as insulation can be put to as you know what the temperature was outside at this time (about 93 degrees F.) and we feel that we were mighty lucky in having a plant well insulated by the Union Fibre Co.

If you wish to refer anyone to us in regard to this matter we will gladly answer all questions.

Yours truly,

INTERSTATE PACKING CO.

By P. A. Jacobson

P.A.J.-K.

☛ **Good Insulation may pay for itself in one day as in this plant.**

Insulation more Necessary than Refrigerating Machine

The insulating material in a cold storage is more necessary than the refrigerating machinery. Before it is possible to carry water it is necessary to have a receptacle to hold it. Before it is possible to cool goods or to cool the temperature of a room, it is necessary to have a receptacle like insulation to prevent the enormous ocean of heat out of doors from flowing into the cooled space as fast as the heat is removed by the refrigerating machinery.

AN EXAMPLE OF THE SAVING EFFECTED BY GOOD INSULATION

In order to show in a graphic way the saving to be made by good insulation, we will build in our minds in the vicinity of Chicago two cold storage buildings, each of them 50 ft. long, 25 ft. wide, and 20 ft. high. We will ignore the inner division of these buildings into rooms and consider only the difference in them due to insulation, or lack of insulation, on the outside walls, ceilings and floors.

The first building is built of thirteen inch brick walls with no insulation, and the second is built with thirteen inch brick walls and four inches of some modern insulation, like Water-

proof Lith board. The ceilings and floors of both buildings are to be constructed of concrete slabs five inches thick, and in both instances the floors rest on the ground.

If the interior of these two rooms is held by refrigeration at 30° F. and the outside temperature is assumed to be, for thirty days, 65° F., there will be thrown upon the refrigerating machine in the first building the necessity of removing 92,295,000 heat units which come through the walls, floor and roof during that time, equivalent to 320 tons of refrigeration, which at 50c per ton will cost $160.00. During the same period, and under the same conditions, there will be taken up in the second building by the refrigerating machine 6,378,750 heat units which come through the insulation, equalling 22.1 tons of refrigeration at 50c per ton or $11.05. Therefore, under the conditions described, there will be a net loss to the owner of the brick uninsulated structure of $148.95, in one month, which he could have saved had his building been properly insulated. And this loss, like Tennyson's brook, goes on forever.

If the temperatures in both buildings are maintained under the same conditions for one year, the owner of the brick uninsulated structure will have spent $1787.40 more than the owner of the insulated structure, and this con-

siders loss in coal consumption only. The extra wear and tear on his refrigerating apparatus which has to work so much harder than that of the insulated plant, is a serious matter, but is not considered here.

Now the cost of insulating a structure of the size and character described complete with Portland cement plaster finish on the walls and ceiling and three inches of concrete on the floor, would not exceed $2150.00, so that the insulation would pay for itself in fifteen months, and furthermore there would be cut off the monthly, daily, hourly loss of real money which cannot be prevented without proper insulation.

NOTE: The calculations of heat transmission in the above example are based on the following:

Heat transmission through 13″ brick uninsulated walls 11.3 B. T. U.'s per sq. ft. per degree difference per 24 hrs.

Heat transmission through 5″ of concrete in roof and floor 28.8 B. T. U.'s per sq. ft. per degree difference per 24 hrs.

Heat transmission through 13″ brick walls and 4″ of Water-proof Lith 1.11 B. T. U.'s per sq. ft. per degree difference per 24 hrs.

Heat transmission through 5″ concrete slabs and 4″ of Water-proof Lith 1.48 B. T. U.'s per sq. ft. per degree difference per 24 hrs.

Through walls and roof the heat transmission was multiplied by the entire temperature difference, 35 degrees. Through the floor slabs which were assumed to rest on the ground in both buildings, the heat transmission was multiplied by half the temperature difference, 17.5 degrees, because of the protection afforded by the earth.

It is difficult to get reliable data on heat transmission through brick, and especially through concrete. The calculations given are the average transmissions from three engineering authorities.

CHAPTER II.

THEORIES OF COLD STORAGE INSULATION

What is Cold Storage Insulation?

A cold storage insulation is one which by its nature or structure resists the conduction of heat or the passage of heat through itself in the highest possible degree.

How Heat Passes through Substances by Conduction

Science says that the transfer of heat from one side of a substance to the other side is due to molecular activity, and this transfer of heat within the body of the substance is called conduction of heat. It is considered that every substance is divided into very fine particles called molecules and the vibration of these is intense when the substance is hot. The denser the substance, the more closely its molecules are packed together and the more quickly the heat-activity is sent through the substance. Steel, for example, being very dense has its molecules close together. When the molecules on the upper surface of a piece of steel are heated, their vibration or heat-activity is quickly transmitted to the next layer and so on until the heat is felt on the under side of the steel.

Heat Transmitted through Gases by Convection

A gas, like air for example, has its molecules widely separated so that it transmits heat very slowly by conduction. But a gas in a large mass transmits heat not by conduction but by convection or the bodily movement of a part of the mass. When a room is heated by a stove the air near the stove is heated first and moves upward, presenting a new cold area to be heated in turn, until shortly all the air in the room is hot. In order to take advantage of the low heat-conductivity of air therefore it must be confined in very small spaces so that it cannot move about.

Materials with many voids or air cells are therefore looked to to present adequate insulating efficiency and much actual experience seems to show that the value of any insulation against heat depends principally upon its porous structure and not so much upon the substances of which it is composed. For example, a light and porous wood like white pine in its natural state will resist the passage of heat in a greater degree than if its fibres are crushed up and pressed closely together so as to form a denser and more solid board.

From abundant data of this sort the principle may be deduced that insulating materials have a low specific gravity, and that the insu-

lating value of any material may be very closely judged by specific gravity. A material which has ten times the specific gravity of water, for example, will conduct ten times as much heat through its molecules as will water. A material which has one-tenth the specific gravity of water will only conduct one-tenth as much heat as water, and hence will be, comparatively speaking, a good insulator. This, then, is a rough but not strictly accurate test of insulation value, how much does it weigh per cubic inch? Because materials of light specific gravity have ordinarily many small cavities, filled with air, in theory, only such substances have possibilities of being made into good insulation.

Materials with Minute Air Cells the best Insulation

By practical tests and long experience as well as theory the law is established that those materials filled with minute air cells possess the highest resistance to the passage of heat energy and are the most perfect insulators.

Materials which are non-conductors of Heat are Important as well as Structure in Cold Storage Insulation

Although structure is very important in insulation — the substances forming the structure may increase or decrease the efficiency of the finished material — certain fibres like cotton, wool, silk and flax, even when densely packed together are good insulators or non-con-

ductors of heat, because of their own natural formation. Their superiority is well known to mankind in general and their use in clothing (which is insulation for human beings) has for centuries proved their worth.

Insulation must not only be efficient but also have such form that it can be handled easily by workmen. Materials in board form are favored for this reason and also because they resist greatly the transfer of heat by conduction.

Conduction of Heat through Insulated Walls

Heat enters into a cold room almost entirely by conduction; the heat waves first stir the molecules of the outside walls and this activity penetrates inward until it meets the insulation, at which point the heat motion becomes slower and slower because of the great resistance it meets in the insulation.

The thicker the insulation is, and the more efficient it is — the smaller is the amount of heat which finds entrance to the room; the smaller is the work to be done by the refrigerant and the more economical is the plant.

Costly Experiments with poor Insulation

Many costly experiments in insulation have been made during the development of the cold storage business in this country. An early type much in favor fifteen years ago, consisted of double walls, the space between being filled

with mineral wool or sawdust, or some other loose packing.

The cost of building the inner wall, was an unnecessary expense. These packings were found to deteriorate through the action of heat and moisture and settle, leaving large spaces in the walls unprotected by insulation. Of course, these unprotected spaces, all unknown to the owner, increased the burden on his refrigerating machinery, increased coal consumption, and took money out of his pocket.

Loose fillings for insulating purposes have been abandoned, not only for these reasons, but because the insurance companies object to them inasmuch as some types, like charcoal, are positively dangerous because of their tendency to spontaneous combustion.

Not often, nowadays, is met an engineer or owner of a cold storage plant who believes in air spaces built up of boards and paper. The meat packers, the earliest industry, perhaps, to insulate extensively, have found these so called air spaces neither efficient nor durable and thousands of square feet of these constructions have been torn out of meat coolers to be replaced by board form insulation. In an air space an inch thick, the heat of the outer walls warms the outside film of air, which thereupon rises because of its lessened density; the inner cold film of

air falls to take the other's place and is in turn warmed so that a circulation frequently very vigorous carries the heat into the interior of the house.

Besides being inefficient, air spaces are depositories of moisture, and the lumber of which they are constructed will rot out frequently within a period as short as five years.

The modern form of insulation which is almost universally desired by engineers, and which is used entirely by the prominent concerns in the refrigeration industry, consists of solid insulating boards which are applied directly to walls, floors and ceilings, either in Portland cement or in asphalt, then covered with Portland cement or wood, applied immediately on the face of the insulation. In these solid board insulations there are tiny air cells of uncountable number.

One of the insulations made by the Union Fibre Company, Water-proof Lith, contains more air cells per cubic inch than any other insulating board.

CHAPTER III.

THE SEVEN NECESSARY REQUIREMENTS FOR GOOD INSULATION

The Seven Requisite Qualities of Good Insulation

Since it may be admitted after the foregoing that cold rooms must of necessity be lined with a special material called insulation, it will be proper to inquire what are the requisite qualities which this insulation must possess.

I Efficiency

Insulating efficiency — or as it is often called non-heat-conducting value — is the essential reason for the existence of insulation. Neither the hardness of steel nor the beauty of porcelain will avail to cover up a lack of this quality, nor will any other quality take its place. This may seem to be self evident, yet there are some manufacturers of insulation who confuse the issue by placing emphasis on subsidary qualities to distract attention from this one, or to confuse the purchaser. An efficient insulation can be installed in minimum thicknesses thus saving valuable storage space to produce dividends.

II Durability

The materials out of which the insulation is made and the mode of manufacture must be such that

the product will last as long as the walls of any ordinary building.

III **Hygienic Cleanness** Since ordinarily food products are stored in cold storages and are naturally and easily ruined by odors the insulation when it is first installed must be odorless and it must not, under any circumstances, decay or mould, so as to develop odors at any subsequent time.

IV **Strength** Insulation must have sufficient structural strength to allow of its being installed by ordinary building methods and by ordinary workmen. Some insulating materials are so weak structurally that they will fall apart of their own weight.

V **Water Proofness** Water is the natural enemy of insulation and it abounds in the shape of moisture in many cold rooms. If it permeates the pores of the insulation the efficiency of the latter will be greatly reduced because water conducts heat very readily.

Insulation, therefore, should not exhibit capillary attraction, which means that if its surface should become wet, it must not suck moisture inwards until it is wet through its whole thickness. No good insulation can withstand

water pressure, or submersion with weights under water because it is composed of small cells filled with air and when it is held under water the water particles being heavier than air, will displace the air and the insulation, after the lapse of sufficient time, depending on the structure, will become waterlogged. The very best insulation can be expected, (a) to be non-hygroscopic—which means it will not absorb moisture from damp air and (b) to have no capillarity or moisture sucking quality as above described. These qualities can be tested by suspending an insulating block so that one surface touches water and then after several days noting whether the water has been drawn into the block.

VI Non-Inflammability

No good insulation is strictly fire proof in the sense that it cannot be destroyed by flames—since all are made of organic materials either wholly or in part. But a good insulation should be non-inflammable and slow burning and capable of being erected in such a manner as to secure the most favorable insurance rates on the buildings in which it is used.

VII Reasonable Cost

The insulation which possesses the necessary requisites above described at a minimum cost should, to say the least, merit

careful consideration by every refrigerating engineer and every owner of a plant which requires insulation.

Waterproof Lith Board

The insulation which best meets all the foregoing requisites is **Water-proof Lith Board.** How Water-proof Lith meets these seven requirements is shown on pages 32 to 47.

INDEPENDENT PACKING COMPANY, CHICAGO, ILL.
Insulated with Water-proof Lith

CHAPTER IV.

TYPES OF INSULATION MADE BY UNION FIBRE COMPANY

Union Fibre Company Makes Every Type of Insulation

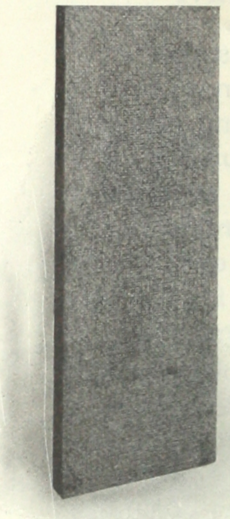
This company can supply every type of insulation now used in cold storage work and sets forth in this book the qualities of all these types but directs special attention to **Waterproof Lith.** To the continuous improvement of this insulation the company has devoted constant daily attention for ten years and has spared neither pains nor money.

This company makes the following insulating materials, a complete description of whose manufacture and uses is given on pages indicated:

1. Water-proof Lith Board	Pages	28 to 32
2. Union Cork Board	"	47 to 51
3. Linofelt (Quilt Insulation)	"	54 to 58
4. Fibrofelt (Hemp Felt Insulation)	"	58 to 60

This company feels it is alone in its ability to give unbiased advice as to the value of each type of insulation since it makes all and can sell any, whereas other manufacturers usually make and sell only one type and hence, for the strongest business reasons, are prejudiced in favor of that type.

CHAPTER V.
WATER-PROOF LITH



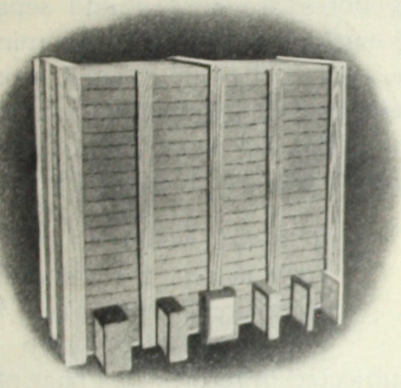
Waterproof Lith Standard Insulation

Waterproof Lith is a standard insulation accepted by the profession of refrigerating engineering and endorsed in the most significant way, that is by continuous use, by the largest purchasers of insulation in the United States.

Waterproof Lith is a successful solution of the problem of making, by skill and machinery and proper materials an insulating board containing within a unit volume, the greatest possible number of extremely small sealed air spaces.

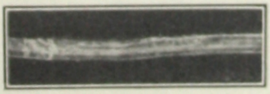
Flax Fibres

The only substances used in its manufacture, except waterproofing compound, are flax fibres and limestone rock wool, from which all shot has been removed by a mechanical process. The flax fibres are obtained from the flax plant



which is cultivated in Minnesota and the Dakotas for seed. In Ireland and Belgium and Russia, this plant is grown for the fibre particularly, out of which linen is made. Our native fibre is not so fine or so long as that used for textiles abroad but it is possessed of all the remarkable insulating value of the best stock. Each individual fibre with a diameter of from .00045 to .0005 of an inch is a hollow cylinder, containing air particles of unimaginable fineness as the following picture shows:

1 cow hair, magnified 200 diameters.



1 Flax fibre magnified 200 diameters.

Compare the relative size of the hair with the flax fibre—the hair is 6 times larger in diameter and 37 times larger in section than the flax fibre. The white streak down the center of the flax fibre is a hollow space.

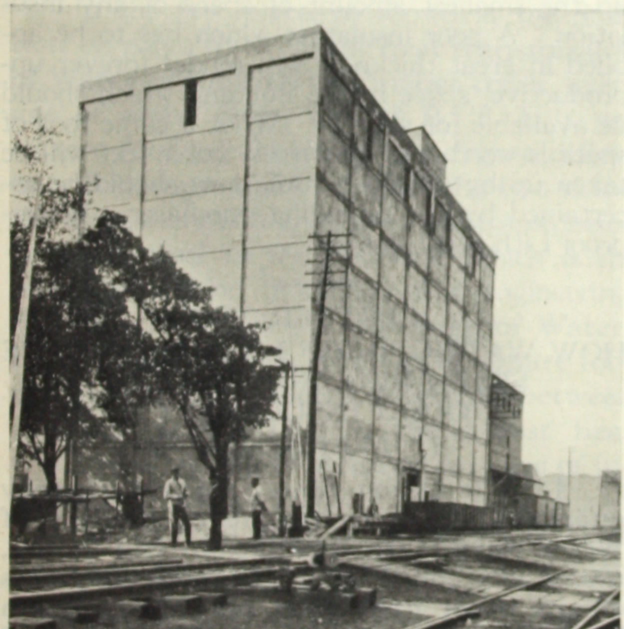
The flax fibres are cooked and separated by combing machines before they are mingled with the rock wool. They have great strength, besides their insulating qualities and are used as a binder for the rock wool. The flax comprises 40% of Waterproof Lith board by volume.

Limestone Rock Wool

The rock wool used in Waterproof Lith is not the mineral wool of commerce. It is made by a patent process by which limestone rock is subjected in retorts to a heat of 3500 degrees Fahrenheit, at which point it liquifies and is blown while hot through petroleum vapor into cooling chambers. Here it resembles cotton in appearance and texture, and is found when tightly packed to have twelve times the bulk of the original rock from which it was blown, therefore it imprisons within itself eleven times its own bulk of air. Its specific gravity is .19.

Rock wool, therefore, contains 8% of stone fibres, and 92% of entrapped air, whereas dried cork contains 47% of wood fibre and 53% of entrapped air. This superior percentage of entrapped air makes rock wool rank the very first of all substances employed in cold storage insulation. Rock wool comprises 58% of waterproof Lith by volume.

Waterproofing The only other ingredient of Waterproof Lith is a waterproofing with which all the fibres are coated in the process of manufacture. There is further a preliminary waterproofing of the rock wool fibres when they are blown through the oil vapor described above.



THE HYGEIA REFRIGERATING CO., ELMIRA, NEW YORK
Insulated with Waterproof Lith

Dimensions of all Lith boards 18 inches by 48 inches, the thickness only differs.

	Wt. per Sq. Ft.		Wt. per Sq. Ft.
½ in. Thickness...	⅔ lb.	2 in. Thickness...	2½ lbs.
1 " " ...	1⅓ lbs.	2½ " " ...	3 lbs.
1½ " " ...	2 lbs.	3 " " ...	3½ lbs.

The heat transmission of Water-proof Lith one inch thick per square foot per degree difference in temperature per 24 hrs. is 5.96 B. T. U.'s.

Water-proof Lith is so efficient that it takes up the smallest amount of space of any insulation. A poor insulation which has to be applied in great thickness will render forever unproductive, space in the building which should be available for storage. What a cubic foot of space is worth and how many cubic feet will be taken up by different insulations should be ascertained by the intending purchaser. Water-proof Lith is the answer.

CHAPTER VI.
HOW WATER-PROOF LITH MEETS THE SEVEN REQUIREMENTS OF GOOD INSULATION
I. EFFICIENCY.

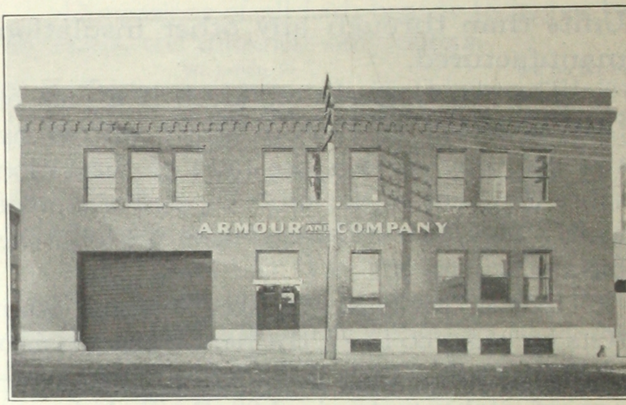
1. **The Union Fibre Company hereby guarantees that the insulating efficiency of Water-proof Lith insulation will equal, under like conditions, the same thickness of any other insulation manufactured in board form. This means that there will not be transmitted through Water-proof Lith insulation a greater number of Heat**

Units than through any other insulation manufactured.

The above guarantee, which is a part of that embodied in every contract written by this company, reveals the faith of the Union Fibre Company in the efficiency of Water-proof Lith. This faith is founded upon the following facts:

In the first place, as shown in the Starr tests on pages 66 to 75, **the heat transmission of Water-proof Lith two inches thick, average of eight tests, is 2.98 B. T. U.'s per square foot per 24 hours per degree difference in temperature between the two sides.** On the assumption that the heat transmission is proportional to the thickness, which is the usual assumption in refrigerating engineering, the heat transmission of **one inch of Water-proof Lith is 5.96 B. T. U.'s per square foot per 24 hours per degree difference between the two sides. This is the lowest heat transmission of any commercial type of insulation in board form.**

But to go further, the Union Fibre Company had comparative tests made at the Armour Institute of Technology to show the heat transmission of its various materials in comparison with all other commercial insulating materials by a method in which all are subjected



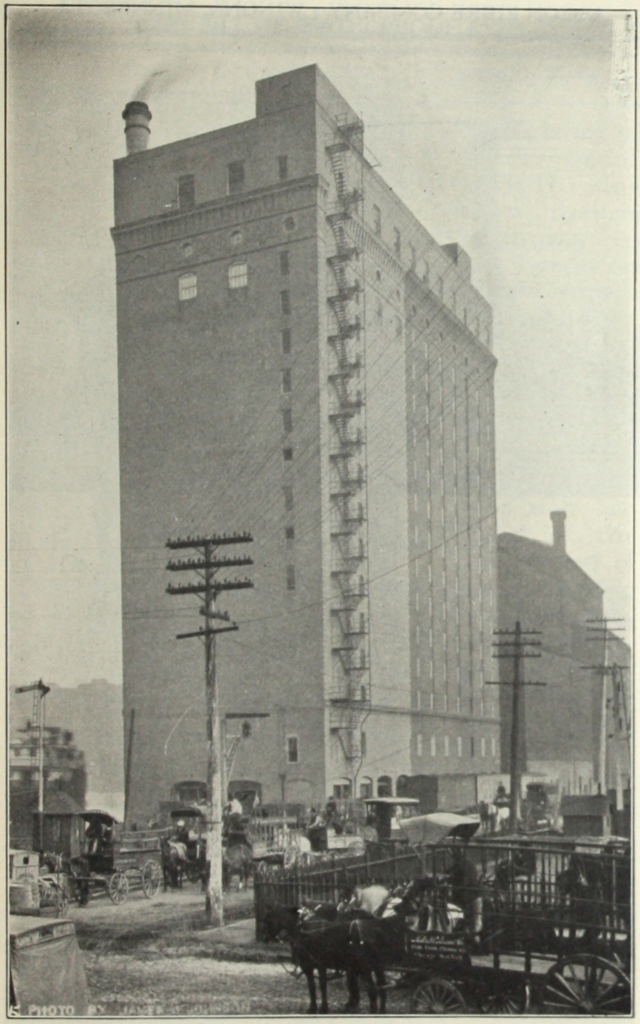
ARMOUR & CO., BRANCH COOLER, SHENANDOAH, PA.
Insulated with Water-proof Lith

to exactly the same conditions, and which reduces to the minimum the human possibility of error since the tests are made on a specially designed machine which depends for its operation, not on the attention of the observer making the test, but on well-known physical laws. Copies of this test sent on application.

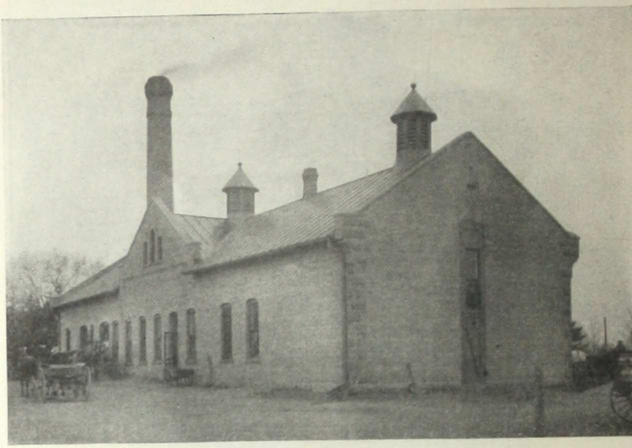
The tests by Prof. Gebhardt at the Armour Institute show that:

Waterproof Lith is $7\frac{1}{4}$ per cent more efficient than any so called pure cork board.

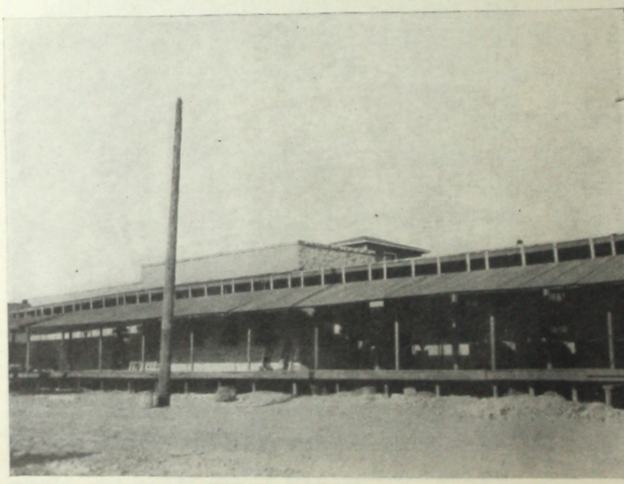
Water-proof Lith is $16\frac{9}{10}$ per cent more efficient than any so-called mineral wool cork, or rock wool block.



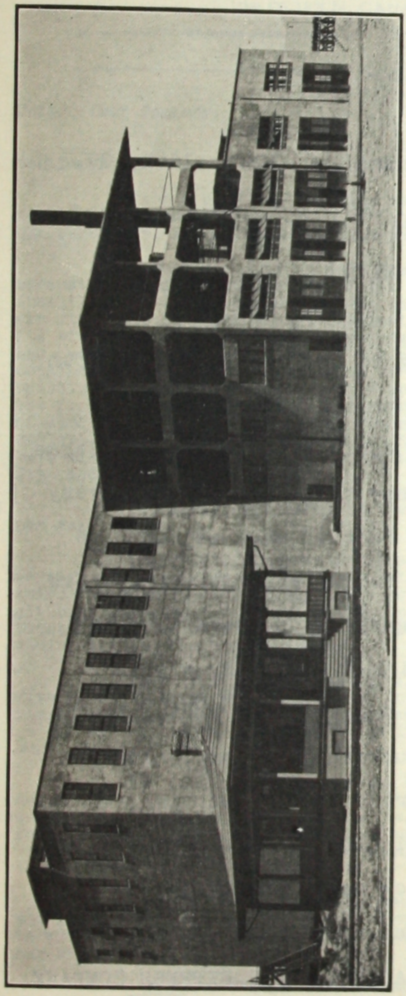
THE NORTH AMERICAN COLD STORAGE COMPANY
Insulated by Union Fibre Company
Efficiency of Waterproof Lith—See letter from the North American Cold Storage Co. on page 39.



LITCHFIELD CREAMERY, LITCHFIELD, MINN.
Cooling Rooms insulated throughout with Waterproof Lith.



FRUIT GROWERS WAREHOUSE, NORTH YAKIMA, WASH.
Apple Storage Rooms insulated with Waterproof Lith.



Pre-cooling Station, Pacific Fruit Express Co., Las Vegas, Nev.

Efficiency of Water-proof Lith Insulation means economy in the operation of cold storage plants.

Consider the letter on the next page from the engineer of the Pacific Fruit Express Company who had charge of the construction of the following fruit pre-cooling plants, the largest in the world: Las Vegas, Nevada; Roseville, Cal.; Colton, Cal.

Water-proof Lith Insulation has been used in all the fruit pre-cooling plants built in the United States because it is an efficient insulation.

PACIFIC FRUIT EXPRESS COMPANY

C. M. SECRIST
GENERAL MANAGER
135 ADAMS STREET
CHICAGO, ILL.

J. W. McCLYMONDS
GENERAL AGENT
FLOOD BUILDING

A. FAGET
CONSULTING ENGINEER
FLOOD BUILDING

IN REPLY PLEASE REFER TO

FILE ____________________

SAN FRANCISCO, CAL., March 16th, 09.

Union Fibre Company,

Winona, Minn.

Gentlemen:-

Replying to your favor of the 10th inst in reference to the effectiveness of the insulation at our Roseville and Las Vegas Factories, would say that this has been very satisfactory. In fact so much so, that we have been enabled to run with just one third of our expansion surface in operation, the temperatures holding practically within a difference of two degrees when shut down from twelve to fourteen hours and this with the house only partly filled with ice; we do not have any difficulty in maintaining temperatures as low as 15 degrees.

Yours very truly,

PACIFIC FRUIT EXPRESS COMPANY,

A. Faget

AF/C

FREE DELIVERY BY BOAT OR RAIL
WHEN PREARRANGED

INSURANCE RATE LOWEST IN THE CITY

THE NORTH AMERICAN COLD STORAGE CO.

FIRE-PROOF WAREHOUSES

109 TO 123 N. CANAL ST.

MEMBER AMERICAN WAREHOUSEMEN'S ASSOCIATION

TELEPHONE MAIN 2641

CHICAGO. Dec. 31, 1907.

Union Fiber Company,
Winona, Minn.

Gentlemen:-

It has been my intention for some months to write you with reference to the Lith and Linofelt insulation of our warehouse, installed during the years 1904-5.

Before deciding on your insulation, I made a very exhaustive study of insulation of all kinds, and before installing it in our warehouse, was thoroughly decided in my own mind that it was the best insulation and, considering its efficiency, the cheapest. My judgment in this respect has been abundantly borne out by the results which we have obtained in this plant. The walls of fourteen floors of this building have been insulated with your insulation, eight of the floors being insulated for freezers, at a temperature of zero or below, and six of the floors being insulated for coolers, at temperatures of 28 to 35 degrees. Five floors have also been insulated, separating the freezers and coolers from each other.

The great efficiency of the insulation is shown by the following:

The fourth floor is a freezer, carried at a temperature of from zero to 8 degrees below zero, while the third floor immediately beneath, is used as an egg room, and although the eggs are piled closely up along the floor of the fourth floor, we have never had any trouble from the frost coming through the insulation.

Last year I opened up the floor insulation in some five or six places, and examined it to see whether, as the years passed, it had accumulated any moisture, but found it as dry as the day it was put in, and its efficiency in no sense impaired.

Our cold storage engineer, who figured the piping necessary to chill the various rooms to the required temperature, evidently figured on old style insulation, for we have not found it necessary to use over about one-fifth to one-half of the piping installed to hold the required temperatures, due to the excellence of the insulation.

I think it only just to your firm to advise you of the results in this warehouse, and I will be glad at any time to write any of your prospective customers with reference to our experience with your insulation.

Yours very sincerely,

A. M. Johnston

President.

II. DURABILITY

The durability of Water-proof Lith depends, of course, upon the life of the materials from which it is made. One of these is rock wool, that is limestone fibres. The other is flax fibres. Since there will probably be no question as to the life of stone fibres, we will direct our attention to flax.

Durability of Water-proof Lith is shown by the following picture

This picture of Lith Insulation on the walls of the Jackson Brewery was taken three years after the earthquake and fire. The insulation had been exposed to the open sky without damage all that time.

The cellulose fibre of flax, which is used entirely in Water-proof Lith, is practically indestructible by ordinary natural agencies. It is not affected by water nor any acid except hydrofluoric acid. Flax fibre was used in the manufacture of mummy cloths of the Egyptians, and has been taken from the tombs in which it was buried for centuries in practically as good condition as new linen.

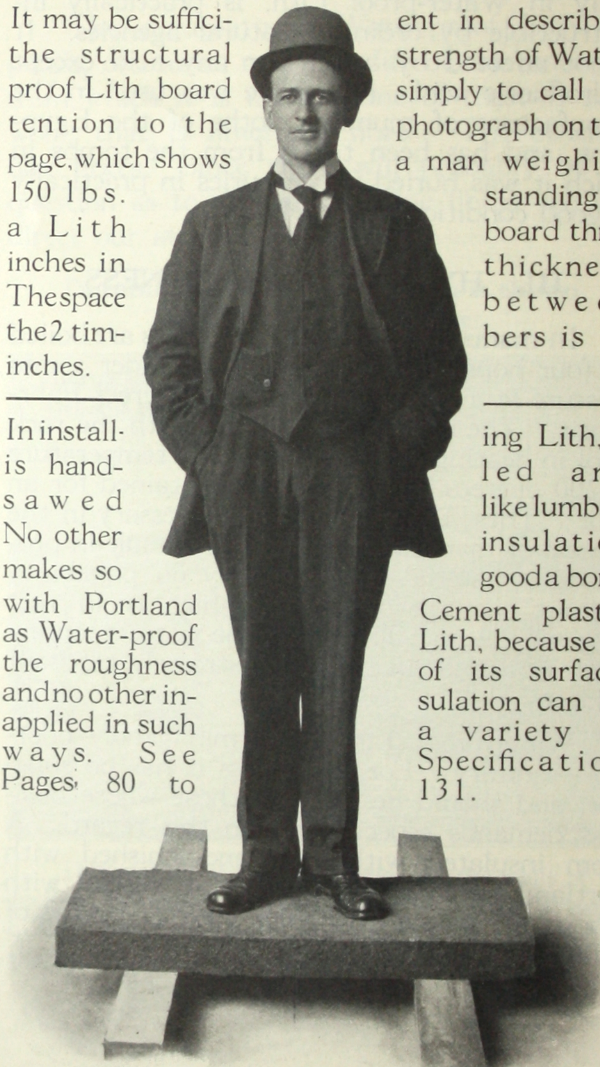
III. HYGIENIC CLEANLINESS

In manufacturing Lith, flax fibres are boiled for four hours in caustic solution under steam pressure at a temperature of 307 degrees Fahrenheit. The flax fibre is mingled with the rock wool in beating engines, in which a temperature of 200 degrees Fahrenheit is maintained for an hour. These temperatures are necessary in the process of manufacture, and they result in producing a material which can by no possibility contain bacteria or germs, which is in fact surgically clean. Then, too, the water-proofing used, a bituminous body, is extremely resistant to decay.

Water-proof Lith is vermin proof—odorless—sanitary. For cleanliness it has no superior, and should be used by those whose business demands especial care in this regard. A room insulated with Lith and finished with Portland Cement plaster may be washed with a hose, if necessary, to quickly remove odors of fruits or other goods.

IV STRENGTH

It may be sufficient in describing the structural strength of Water-proof Lith board simply to call attention to the photograph on this page, which shows a man weighing 150 lbs. standing on a Lith board three inches in thickness. The space between the 2 timbers is 24 inches.



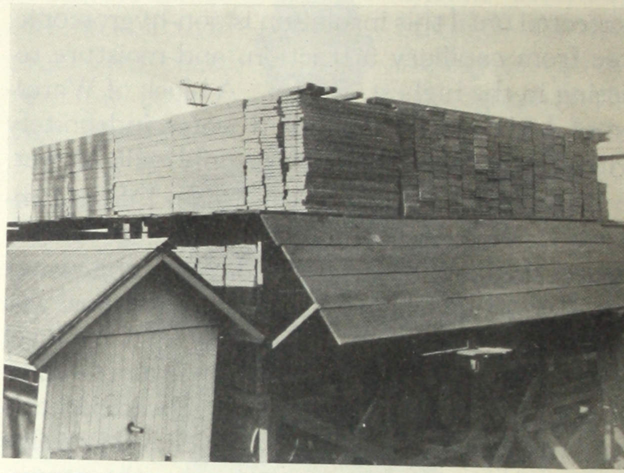
In installing Lith, it is handled and sawed like lumber. No other insulation makes so good a bond with Portland Cement plaster as Water-proof Lith, because of the roughness of its surface, and no other insulation can be applied in such a variety of ways. See Specification Pages 80 to 131.

V. WATERPROOFNESS

The water-proofing of Lith board has been perfected until this insulation is non-hygroscopic. free from capillary attraction, and moisture resisting in the highest degree. A block of Waterproof Lith can be floated in water indefinitely without damage; the surface only will be wet.

In the laboratory of the Union Fibre Company at Winona a two months' test to demonstrate the capillary attraction and the water absorbing qualities of various insulations was conducted in May and June of 1910. On a level table was placed a pan which contained water one-quarter of an inch deep. The water in this pan was renewed to this exact level every twelve hours to provide for absorption by the atmosphere. Samples of Water-proof Lith, of Union Cork Board, and of Pure Cork Board, each weighing thirteen ounces, and each having the same surface area exposed to the water, were placed in this pan and carefully weighed at the following intervals:

		WATER-PROOF LITH	UNION CORK	PURE CORK BOARD
At start	Weight	13 oz.	13 oz.	13 oz.
Second day	"	$13\frac{1}{2}$	13	$13\frac{1}{2}$
End of first month	"	14	$13\frac{1}{4}$	14
End of second month	"	$14\frac{1}{4}$	$13\frac{1}{4}$	$14\frac{1}{4}$



This Photograph taken January 28th, 1914, at the Pacific Fruit Express Repair Yards, North Ave., 26th St., and South Pacific Tracks, Los Angeles, Cal. The material in pile, Union Fibre Company's Waterproof Lith, used to insulate and Waterproof floors of refrigerator cars. The above material piled out doors, as an extreme waterproof test, on January 10th the rainfall, as shown by Government report, from said date to January 28th being 9½ inches. Lith not damaged and was ready for use any time after two hours of sunshine.

It is not to be expected that any insulation in actual service will be constantly subjected to water action as were these samples. The tests show, however, clearly that Water-proof Lith, even with a stream of water running over the face of the insulation, will not absorb any water into its interior because of its entire freedom from capillary attraction.

A word about submerging insulation under water by means of weights. In a test of this sort the most efficient insulation, that is the one with the greatest number of air cells, appears to the worst advantage. The weight of the water drives out the air and the cells of the insulation are filled after a time.

This test is not a fair one to any material because it does not show what happens at any time in practice. If an insulation when its surface is wet resists capillary attraction so that the moisture is not drawn into its interior, it is capable of the severest service.

VI. NON-INFLAMMABILITY

Water-proof Lith board is a slow-burning standard insulating material. When it is installed in a cold storage or any other type of building in conformity with the Underwriters' requirements, viz., set up in Portland cement plaster as described on pages 87 and 88, the build-

ing in which it is so installed, if conforming to the Underwriters' requirements in other particulars, will be given the lowest rate of insurance possible to be obtained for that type of building.

The Union Fibre Company guarantees that Water-proof Lith board will enjoy this lowest rate of insurance and affirms specifically here that no other insulating material can secure a lower rate of insurance than Water-proof Lith.

The Union Fibre Company intends this guarantee about insurance to be taken in the widest and most liberal sense, and welcomes an opportunity to present convincing documents to its prospective clients. It also takes pleasure in referring to prospective clients the many fire-proof cold storage houses insulated with Water-proof Lith, some of whose pictures appear in this book, which are enjoying the lowest insurance rates possible to be obtained by any storage building.

VII. REASONABLE COST

The cost of insulation depends, of course, upon the amount required and the manner of its erection. On pages 80 to 131 there are descriptions and specifications of the different standard ways in which insulation may be installed. For particular conditions there are, of

course, an almost infinite number of ways in which different insulations can be applied.

The prices quoted by this company are fair and reasonable, and considering the efficiency of the insulation the price of Water-proof Lith is lower than any other commercial block insulation.

The Union Fibre Company at its Winona office maintains an Engineering Department and submits sketches and proposals for erecting insulation without cost to any inquirer.

CHAPTER VII.
UNION CORK BOARD

Pure Cork and Asphaltum in Union Cork Board

Union cork board contains two ingredients only, pure natural cork granules and a specially selected asphaltum for a water-proof binder.

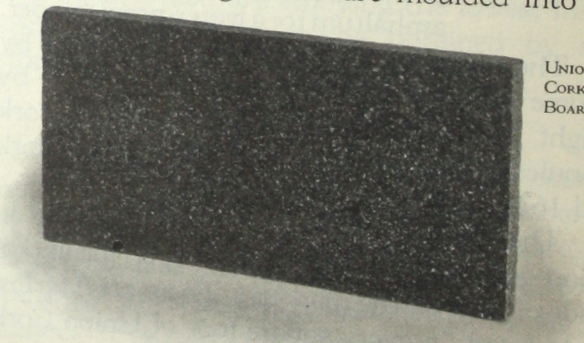
The proportions of the two ingredients by volume are cork 95.2%, asphaltum 4.8%; by weight the proportions are $2\frac{1}{2}$ pounds of cork granules to $\frac{1}{2}$ pound of asphaltum, or $83\frac{1}{3}$% cork and $16\frac{2}{3}$% asphaltum by weight.

There is **more cork** by actual weight in union cork board than in any other insulation made of cork on the market. There are $1\frac{1}{4}$ lbs. of pure cork in every square foot of Union Cork

one inch thick and all the other thicknesses are in exact proportion. It must not be forgotten that what the purchaser buys in cork insulation is **cork.** No fine arguments can successfully controvert this fact. Remember it, reader, when you make your purchase.

Pure Cork from France and Spain in Union Cork Board

The cork wood for this board is purchased by the company in Southern France and Spain. When it reaches the factory it contains from 10 to 25% of moisture, for which reason a special drier is used in which the granules are subjected for an hour to a temperature of 250° and dried thoroughly. The dried hot granules, are blown in pipes from this drier, without coming in contact with the air, to the mixing machine, in which each granule is coated with Antiaqua Brand Asphaltum at a temperature of 350°. Then the granules are moulded into in-



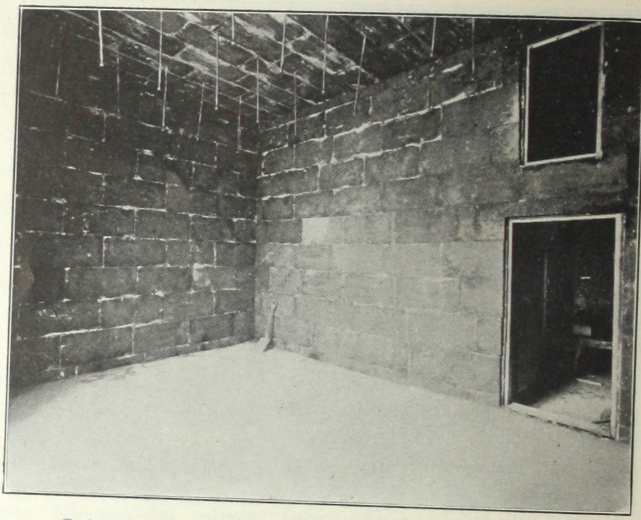
Union Cork Board

Applying Union Cork Board in
Union Ice Company's Plant, San Diego, Cal.

dividual boards during which operation no more pressure is applied than that necessary to make a close union of all the particles. Each granule of cork contains the full insulating value given it by nature and each one is water-proofed.

The heat transmission of Union Cork Board one inch thick is 6.82 B. T. U.'s per square foot per degree difference per 24 hours.

Dimensions of all Union Cork boards 16⅝ inches by 34⅝ inches—(4 sq. ft.) thickness only differs. Union Cork Boards have each four



Cork Board Insulation used in Minnesota State Prison, Stillwater

HANLEY-CASEY COMPANY
CONTRACTING ENGINEERS
CHICAGO

STILLWATER, MINN., December 5, 1913.

UNION FIBRE CO.,
Winona, Minn.

GENTLEMEN:

In further reference to your communication of several days ago and confirming assertions therein contained, we are forwarding you under separate cover photographs of the progress of the work during installation. These photos hardly do the work justice as it was almost impossible to take photos of the different rooms showing the insulation to any very good advantage.

Our Cooler rooms here are three in number with a total over-all length of 35′, width 26′, and height 12′ and it required two carload of your cork for the insulation of same.

Since the rooms have been placed in use we have found the insulating properties much better than we had anticipated and this coupled with the ease and simplicity of installation and its stickability when placed makes us an enthusiastic user of your products for a like nature in the future. We are recommending this insulation on several contemplated installations and shall communicate with you at the proper time.

Trusting that these photos will be sufficient for your use and assuring you of your liberty to use this letter or any parts of same as you see fit in advancing the sale of your product, we are,

Yours very truly,
HANLEY-CASEY COMPANY
By F. W. GRAHAM,
General Superintendent.

FWG-WMP

square feet of area, other cork boards three; the larger area means fewer joints and added insulating efficiency.

Further, plaster makes an excellent bond with the rough surface of Union Cork Board. Plaster will not adhere to the smooth surface of so-called pure cork board unless grooves are cut in it and this reduces insulating efficiency.

	Wt. per Sq. Ft.		Wt. per Sq. Ft.
1 inch Thickness	1½ lbs.	2½ inch Thickness	3¾ lbs.
1½ " "	2¼ lbs.	3 " "	4½ lbs.
2 " "	3 lbs.		

ASPHALTUM—ANTIAQUA BRAND

Asphaltum

The Asphaltum used in Union Cork Board is the purest and best this company can buy.

It is called by our trade-name, Antiaqua Cement, and is a flux of several asphalts without odor and capable of resisting the action of water permanently. In tests extending over six months the amount of absorption or disintegration of this asphalt under water action was less than twenty grains in six pounds spread over eleven square feet.

The foreign mineral constituents of our Antiaqua Cement are less than two-tenths of one per cent. These foreign mineral elements are the ones acted upon by water in ordinary asphalts, hence this explains the superiority of our Antiaqua under water action

Antiaqua Analysis.

Melting Point	200° F.	Total Bitumen	99.8%
Penetration at 77°	34	Mineral Matter	.125%
Specific Gravity	1	Loss in heating to 310° F.* for 20 hrs.	.5%

*This is the temperature at which Antiaqua should be used.

This asphaltum has no odor under any circumstances even when heated to 400° F. as any observer can assure himself of by sending for a sample and testing it.

Besides being used in the manufacture of our Union Cork Board, Antiaqua Brand asphaltum is used to coat insulating boards when they are being erected in buildings, and also to coat walls as a water-proofing. These uses of Antiaqua are described in the specification pages 80 to 131.

ADVANTAGES OF UNION CORK BOARD OVER OTHER TYPES OF CORK INSULATION

Burned Cork—Its Disadvantages

There are many extravagant claims put forth by those manufacturers who sell a so-called pure cork board, by which they mean a board the granules of which are burned until they have lost their natural resiliency. This company when it began the manufacture of cork investigated carefully and chose the type of board known as Union cork, described above.

Among the decisive considerations mitigating against a burned cork board are the following:

Cork wood consists practically of an aggregation of minute air vessels having thin globular walls. These cork cells are permeable by air and if subjected to pressure in one direction the

cork will gradually part with its occluded air by effusion, that is, by its passage through the porous walls of the cells in which it is contained. The gaseous part of cork, that is, the air contained in the cells, constitutes 53% of its bulk, and this makes it valuable as an insulation. The 47% of woody cork fibres is not much more efficient as an insulator than any other species of wood. When, therefore, a quantity of granulated cork two inches thick is compressed to a board one inch in thichness, the percentage of woody fibre is increased and the percentage of air spaces (the valuable part, for insulating purposes) is decreased. Cork subjected to this

GRAND ISLAND BREWING CO.
Grand Island, Neb.
Insulated with Union Cork Board.

pressure will expand when the pressure is released unless it is burned and the elasticity of the cells is broken down permanently. But making cork board into charcoal increases its susceptibility to moisture materially and adversely affects its durability, and does not add anything to its insulating value.

How Burning Destroys Life of Cork

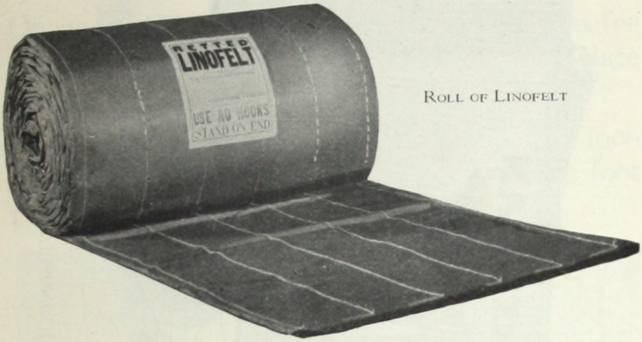
A simple test, to show how burning destroys the life of cork, is to take a small piece of the so-called pure board and set it for two weeks or longer on a window sill where the air and sun will have full play upon it. At the end of this time the cork will be friable under very slight pressure of the thumb and the granules will flake off in small pieces of charcoal. Try this same test with Union Cork Board. It will not be affected or injured in any way.

CHAPTER VIII.

LINOFELT

Quilt Insulation

Refrigerator Linofelt is a quilt insulation made of flax fibres cooked with steam and chemicals, that is, subjected to the processes known as degumming and retting, formed into a bat ¼ or ½ inch thick (like cotton batting) and quilted



ROLL OF LINOFELT

between two sheets of Linocel water-proof paper.

Linofelt is used very largely as insulation in domestic refrigerators, in fact, most of the large builders of domestic ice boxes are our regular customers. It is likewise used in insulation of the smaller cold storage and packing plants.

Linofelt in Refrigerator Cars

Its largest use is in lining refrigerator cars and for this purpose it is bought by every important car line engaged in transporting perishable products. Practically all the fruit from California is protected on its journey through the arid deserts of the west by Linofelt because nearly every car of every transcontinental refrigerator line is insulated with Linofelt.

Linofelt for Ice Houses

For ice houses especially and other structures where wood may be used, Linofelt is a superior form of insulation at a moderate price.

LINOFELT INSULATED
REFRIGERATOR CAR

There are 30,000 Refrigerator Cars Insulated with LINOFELT

On pages 120 to 126 there are specifications for economical insulation of ice houses, chocolate rooms, etc., in which Linofelt is to be used.

The heat transmission of Linofelt per inch in thickness is 4.55 B. T. U.'s per square foot per degree difference per 24 hours.

Union Pacific Ice House, Grand Island, Nebr.
Insulated by the Union Fibre Company

Refrigerator Linofelt ¼ inch thick is made in rolls 3 feet wide and 66⅔ feet long, containing 200 square feet to the roll. In the ½ inch thickness the regular rolls are 3 feet wide and 40 feet long, containing 120 square feet to the roll.

On special order Linofelt can be furnished up to 112 inches in width and any length desired and also in any thickness as follows:

	Wt. per Sq. Ft.		Wt. per Sq. Ft.
1/4 in. Thickness...	.30 lb.	3/4 in. Thickness...	.54 lb.
1/2 " " ...	.42 lb.	1 " " ...	.66 lb.

CHAPTER IX.
FIBROFELT

Fibrofelt Hemp Fibre Insulation

Fibrofelt is an insulating felt made of specially selected and chemically treated hemp fibres, of great strength and high insulating value. It is light and strong. It is furnished in the form of a board which can be handled and sawed like lumber.

Sheet of Fibrofelt 1/2 inch thick, 3 feet wide, 8 feet long

Ice Storage House, Yuma Ice Co., Yuma, Ariz.
The walls are insulated with Water-proof Lith.

Fibrofelt is particularly useful for insulation in structures where light weight is essential. It has been largely used in ice houses, in cold storages of wood construction, and in other places like chocolate rooms.

Manufacturers of domestic refrigerators, fireless cookers, incubators and similar appliances find it particularly valuable for insulation because it will be furnished cut to the exact area of the space to be filled by insulation. The workmen can apply Fibrofelt to this space with the greatest ease. It is a good insulation and its cost of application is less than that of any other form.

The heat transmission of Fibrofelt per inch

in thickness is 5.4 B. T. U. per sq. ft. per degree difference per 24 hours.

Another great advantage of Fibrofelt over other insulating boards is the fact that it can be furnished in large sizes 3 ft. wide and 8 ft. long, and of five thicknesses, from one-quarter inch to one and one-half inches, as described below:

	Wt. per Sq. Ft. Uncrated	Wt. per Sq. Ft. Crated
$\frac{1}{4}$ inch Thickness	.35 lbs.	.45 lbs.
$\frac{1}{2}$ " "	.65 "	.75 "
$\frac{3}{4}$ " "	.95 "	1.05 "
1 " "	1.25 "	1.35 "

CHAPTER X.

MISCELLANEOUS INSULATING MATERIALS

UNION ROCK FIBRE WOOL

Union Rock Fibre Wool is manufactured in our mill at Yorktown, Indiana, situated on a large deposit of silica bearing limestone rock.

The Rock Wool is made under our patented processes. The rock is subjected, in furnaces, to a heat of 3,500 degrees F., at which point it liquifies and running through the mouth of the furnace is met by a high pressure steam blast which expands it with great force into fine silken threads. While speeding from the steam blast

towards the cooling chamber the fine fibres pass through oil vapor which makes them soft and pliable and removes the minute particles of stone dust. Union Fibre Company's rock wool is constant in chemical structure and will not disintegrate. It weighs 14 pounds to the cubic foot.

A cubic foot of rock fibre wool contains $8\frac{1}{3}$ per cent of rock fibres and $91\frac{2}{3}$ per cent of entrapped air. This explains why rock wool is such a good insulating material. Rock wool is sold in bulk in 50 pound bags in carloads or less than carload lots.

WATER-PROOF INSULATING PAPER

The Union Fibre Company supplies nearly every railroad in the United States with Refrigerator Linofelt for insulating refrigerator cars. The best water-proof insulating paper is called for on this work.

This, called Linocel Insulating Paper, is made according to the company's special formula and is a 3-ply black water-proof paper. A greater percentage of jute, flax and rope stock is used in its manufacture than in any other commercial paper.

Linocel paper is supplied in any width up to 112 inches. In rolls 36 inches wide (the usual width for insulating work) containing one thousand square feet, it weighs 90 lbs. to the roll.

GRANULATED CORK

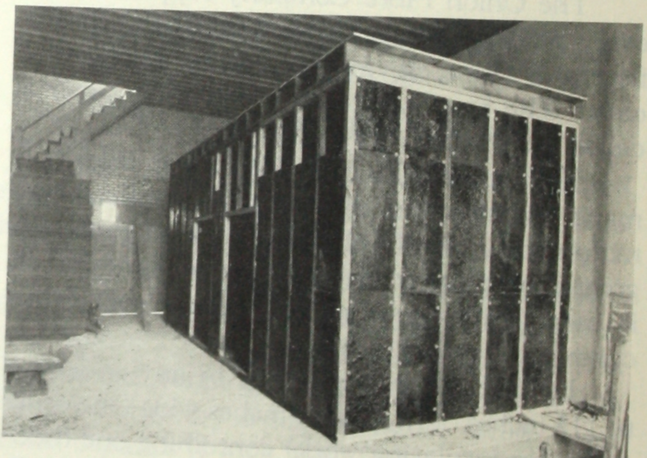
Granulated Cork is supplied by the Union Fibre Company in various grades. Details as to size granules required and prices on application.

FREIGHT RATES GRANULATED CORK IN BAGS

	Less Carloads	Carloads
Official Classification	First Class	Third Class
Southern Classification	First Class	Fifth Class
Western Classification	First Class	Third Class
Transcontinental Classification	First Class	Special

MINIMUM CARLOADS GRANULATED CORK

Official Classification	12,000 pounds
Southern Classification	24,000 pounds
Western Classification	12,000 pounds
Transcontinental Classification	24,000 pounds



Cold Storage Room in Commission Block, St. Paul, Minn., Showing Waterproof Lith Insulation.

THE FACTORIES OF THE UNION FIBRE COMPANY

The Union Fibre Company has two factories, one at Winona, Minnesota and the other at Yorktown, Indiana. At both points large stocks are carried.

At the Winona, Minnesota, factory are manufactured Water-proof Lith, Refrigerator Linofelt, Fibrofelt and Union Cork Board. Shipments of any of these materials in carload and less than carload lots are made from this point.

At Yorktown, Indiana are manufactured Water-proof Lith and Rock Fibre Wool. Shipments of these materials are made from this point in carload and less than carload lots.

All insulating materials in carlots are usually forwarded without crating—less than carload shipments have to be crated which adds slightly to their cost.

Prompt shipment of any order immediately upon its receipt is guaranteed by the Union Fibre Company. Nothing but insulation is made at its factories and the stock is never allowed to fall below fifty carloads. Many companies promise prompt shipment. This company has built a reputation for it.

FREIGHT RATES

WATER-PROOF LITH

	Minimum Carloads	Less Carloads	Carloads
Western Classification	30,000 lbs.	Third Class	Fifth Class
Official Classification	30,000 lbs.	Third Class	Fifth Class
Southern Classification	30,000 lbs.	Third Class	Fifth Class
*Pacific Coast Points	24,000 lbs.	$1.50 per 100 lbs.	$1.00 per 100 lbs.

FIBROFELT AND LINOFELT

Western Classification	†20,000 lbs.	Third Class	Fifth Class
Official Classification	†15,000 lbs.	Second Class	Fourth Class
Southern Classification	20,000 lbs.	Third Class	Fifth Class
*Pacific Coast Points	24,000 lbs.	$1.50 per 100 lbs.	$1.00 per 100 lbs.

UNION CORK BOARD

Western Classification	30,000 lbs.	Third Class	Fifth Class
Official Classification	†20,000 lbs.	Third Class	Fifth Class
Southern Classification	30,000 lbs.	Third Class	Fifth Class
*Pacific Coast Points	24,000 lbs.	$1.50 per 100 lbs.	$1.00 per 100 lbs.

BUILDING PAPER

Western Classification	36,000 lbs.	Third Class	Fifth Class
Official Classification	36,000 lbs.	R 26	Fifth Class
Paper coming from the east commodity rates apply	40,000 lbs.		
Southern Classification	30,000 lbs.	Fifth Class	Class A
*Pacific Coast Points	24,000 lbs.	$1.50 per 100 lbs.	$1.00 per 100 lbs.

ASPHALTUM

Western Classification	40,000 lbs.	Fourth Class	Class D
Ship from Chicago and common points commodity rates apply			
Official Classification	36,000 lbs.	Fourth Class	Sixth Class
Commodity rates also apply in some parts of this territory and when such is the case the minimum is	40,000 lbs.		
Southern Classification	20,000 lbs.	Sixth Class	Class A
*Pacific Coast Points	24,000 lbs.	$1.50 per 100 lbs.	$1.00 per 100 lbs.

MINERAL WOOL

Western Classification	†20,000 lbs.	Third Class	Fifth Class
Official Classification	†20,000 lbs.	Third Class	Fifth Class
Southern Classification	20,000 lbs.		Fifth Class
*Pacific Coast Points	24,000 lbs.	$1.50 per 100 lbs.	$1.00 per 100 lbs.

In Western Classification we are able to load as a carload Mineral Wool, Water-proof Lith with Linofelt and Fibrofelt, fifth class rate, minimum 30,000 lbs.

*Pacific Coast Points—All insulating materials used in the construction of cold storage plants may be shipped together in one car. Page 49, West Bound Trans-Continental Tariff No. 4H: L. C. L. $1.50—C. L. $1.00 per one hundred pounds.

†Minimum varies with size of car.

CHAPTER XI

TESTS TO DETERMINE INSULATING EFFICIENCY

The Union Fibre Company in its laboratory at Winona, Minnesota, makes daily tests of its insulating materials to keep the efficiency of its product up to its standard. It does not consider these tests made in its own laboratory and under complete control of its own employes are interesting to the public at large. The only tests which are worthy of presentation to the public are those made away from the company's factory and by unbiased experts.

The tests following were made by the Starr Engineering Company. Each method is explained and defended by a competent and unbiased engineer. Tests show the superiority of Waterproof Lith as an efficient insulating material.

In making tests on insulation the endeavor is to find out how much heat will pass through a given insulation in a certain time, with a certain difference in the temperature on each side of the insulation so tested.

The standard of measurement in heat transmission is the British Thermal Unit—which

represents a definite quantity of heat—that amount which will raise the temperature of one pound of water from 39° F. to 40° F. 144 B. T. U. will melt a pound of ice at 32° F. If, therefore, a certain insulation allows 1 B. T. U. to pass through it in one day (for each degree of difference in temperature between the two sides) and another insulation allows 2 B. T. U.'s to pass under the same conditions, the former is the better insulation because it permits only half as much heat to pass through it as the latter.

STARR ENGINEERING CO.,
50 CHURCH STREET
FULTON BUILDING—HUDSON TERMINAL
NEW YORK CITY

JOHN E. STARR, PRES. TELEPHONE CONNECTION

October 21, 1911.

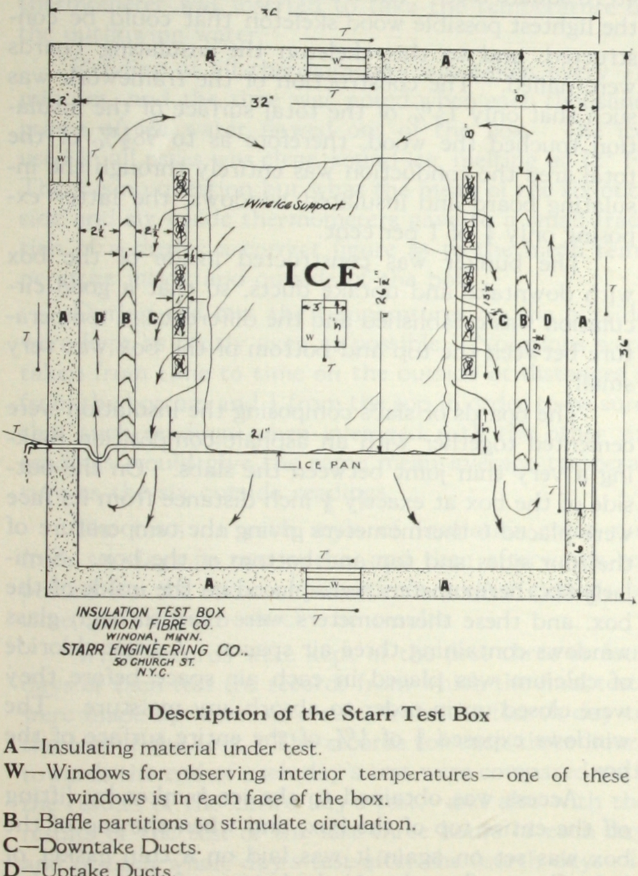
Union Fibre Co.,
Winona, Minn.

Gentlemen:

Referring to the conduct of the series of tests run by me in 1910 and 1911 on the insulating value of materials furnished by you, I hand you herewith a drawing showing the construction of the test boxes.

In all of this series of tests the material tested was two inches in thickness. The box was a cube three feet outside measure and the actual mean surface was

STARR ENGINEERING COMPANY'S TEST BOX



Description of the Starr Test Box

A—Insulating material under test.

W—Windows for observing interior temperatures—one of these windows is in each face of the box.

B—Baffle partitions to stimulate circulation.

C—Downtake Ducts.

D—Uptake Ducts.

The arrows indicate the direction of air circulation.

T—Thermometers.

48.16 square feet. The framework of the box was of the lightest possible wood skeleton that could be constructed, and to this skeleton the insulating boards were nailed. The construction of the framework was such that only $1\frac{1}{2}\%$ of the total surface of the insulation touched the wood, therefore as to $98\frac{1}{2}\%$ of the total area the conduction was entirely through the insulating board and insulated windows, the latter exposing only $\frac{1}{2}$ of 1 per cent.

The bunker was constructed inside of the box with downtake and uptake ducts, so that a good circulation was established and the difference in temperature between the top and bottom of the box was very small.

The boards or slabs composing the insulation were cemented together with an asphalt composition making a very thin joint between the slabs. On the outside of the box at exactly $\frac{1}{2}$ inch distance from its face were placed 6 thermometers giving the temperature of the four sides and top and bottom of the box. Similarly six thermometers were placed on the inside of the box, and these thermometers were read through glass windows containing three air spaces. A little chloride of calcium was placed in each air space before they were closed up in order to absorb any moisture. The windows exposed $\frac{1}{2}$ of 1% of the entire surface of the box.

Access was obtained to the ice bunker by lifting off the entire top of the box, and when the top of the box was set on again it was laid on a thin gasket of light Canton flannel. At the bottom of the ice bunker was a pan with a trapped pipe leading to the outside of the box. This pipe was dammed at its outer end so that it remained practically full of water at the cross

section just at the outer edge of the box, and here a thermometer was inserted to take the temperature of the outflowing water.

Reading of all thermometers was taken every 15 minutes, and the time was noted when each thousand grams of ice water flowed out of the box. The ice used in all cases was clear, sound ice, melting at 32° F. There is no question but what the mean of the six outside and six inside thermometers gave to a small fraction of a degree a correct figure as to the mean temperature inside and outside of the box.

During the test the temperatures on the outside were kept as nearly even as possible. Notations were taken from time to time on the outside at distances ¼ from the bottom and ¼ from the top in order to be sure that such readings when averaged with the other six readings would give the same mean average temperature as the six outside readings.

The tests on each style of insulation were run from six days to two weeks, and then afterwards repeated for the same or sometimes greater periods of time, in order to check the results.

While records were kept of the first three or four days of each test the records from which the final tests were made up were, as a rule, from the fourth day to the end of the test. The records for each three hours towards the end of each day's test were compared with the results of the entire day's test, and also with the results of the test of the last three hours of each day and of each whole day's test after the fourth day. It was observed during the tests that it took from 48 to 60 hours before the insulation was progressively cooled off, and before the insulation was transmitting heat

regularly and at the same rate per degree of difference from hour to hour. The records all show, when analyzed by periods of an hour or two or three hours, remarkable uniformity in the rate of transmission. On one or two occasions variations were found in the rate of transmission, which in three cases on retesting were found to be due to conditions of moisture in the atmosphere. In every case but one the tests made at humidities from 48 to 51 exhibited great uniformity. In one case there was a variation, and it was found that some poor ice had been placed in the box. On rerunning the test with good ice the same figures were obtained as had been obtained on a previous test with good ice.

In my opinion this method of conducting a test on a box exposing nearly 50 square feet of surface is the most practical method of arriving at the true insulating value of the material from a quantitative standpoint, and where two different materials are tested at the same time and under the same conditions it gives the best practical qualitative comparison, especially when it is desired to arrive at the value of the insulation when transmitting heat from air to air.

Under the conditions of a test, such as herein described, the conditions as to the movement of the air are those most frequently met with, that is to say, a natural and usual circulation both inside and outside of the refrigerator. Where a blast of air is used both inside and outside of the test boxes for the purpose of equalizing the temperature, it is probable that a greater degree of transmission is effected than under most conditions prevailing where insulation is used. It appears to me that the main point to be settled is

that the readings of the thermometers do actually give within a small fraction of correctness the average mean temperature on the inside and the outside of the surface, and I am satisfied that the thermometry in these tests did actually disclose the conditions of temperature inside and outside of the entire surface with great accuracy. It seems to me that tests where ice or ice water is in contact with the surface on the inside of the box and air or warm water in contact with the outside of the insulation will give a different value to the rate of conductivity than tests conducted in the manner above described, and that such tests are only of value in making comparisons, because in practice we have no such conditions. A test with the one side of the insulation in contact with ice water and the other side of the insulation in contact with air would be valuable as establishing conducting conditions existing in brine tanks, ice water tanks and ice tanks, and would undoubtedly show a higher rate of transmission than in tests made with air contacts made on both sides. I consider also that the comparatively large amount of surface used in making the above tests give more reliable results than are given by tests in boxes 1 to $2\frac{1}{2}$ feet square.

Very truly yours,

John E. Starr

HEAT TRANSMISSION TESTS ON WATER-PROOF LITH BOARD, Two Inches in Thickness

Date 1911		Average Temps. Outside	Inside	Range*	B. t. u.	Remarks
March	22	72.94	44.50	28.44	2.90	Test 1
"	22	73.63	44.78	28.85	2.99	" 1a
"	29	74.28	44.07	30.21	2.99	" 2
"	31	72.90	43.80	29.10	3.04	" 3
April	3	64.25	41.26	22.99	2.80	" 4
"	4	64.25	41.97	22.28	3.06	" 5
"	5	71.52	43.23	28.29	3.07	" 6
"	11	68.45	42.66	25.79	2.88	" 7
"	12	67.96	42.43	25.53	3.09	" 8

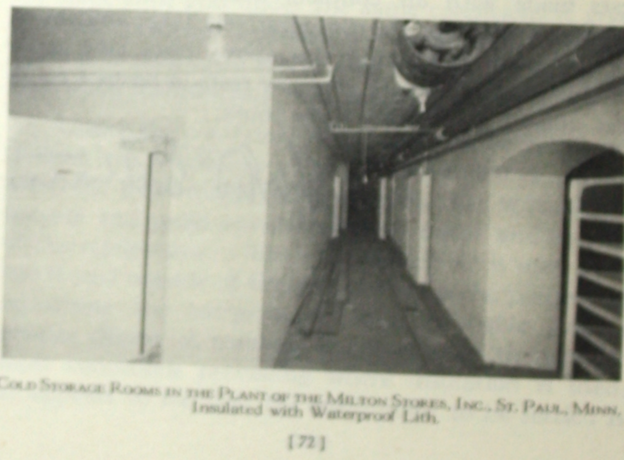
*Range means the difference in degrees Fahrenheit between the temperature of the inside of the test boxes and the temperature of the room outside the boxes.

Heat transmission in B. T. U. per sq. ft. per deg. diff. per 24 hrs. (average of 8 tests) 2″ thick **2.98**

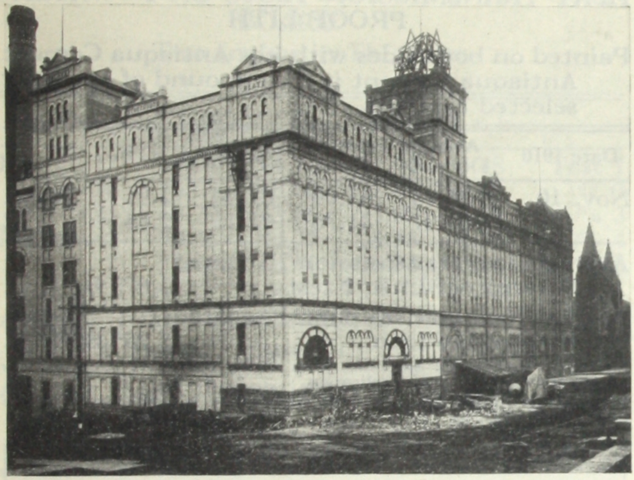
Heat transmission in B. T. U. per sq. ft. per deg. diff. per 24 hrs. 1″ thick **5.96***

Hourly readings for each day from which above summary was made will be furnished on application.

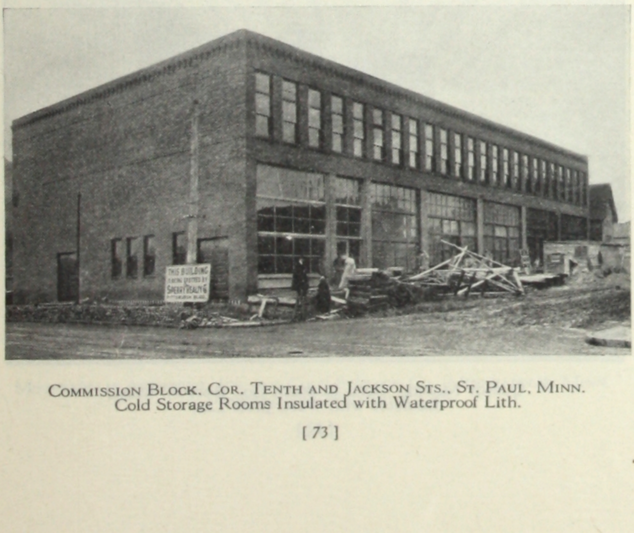
*On the assumption that the heat transmission is proportional to the thickness.



Cold Storage Rooms in the Plant of the Milton Stores, Inc., St. Paul, Minn. Insulated with Waterproof Lith.



Val Blatz Brewing Co. Stock House, Milwaukee, Wis.
Insulated by the Union Fibre Company



Commission Block, Cor. Tenth and Jackson Sts., St. Paul, Minn.
Cold Storage Rooms Insulated with Waterproof Lith.

HEAT TRANSMISSION TESTS ON 2″ WATER-PROOF LITH

Painted on both sides with hot Antiaqua Cement
Antiaqua Cement is a compound of specially selected asphalts.

Date 1910	Average Temps. Outside	Inside	Range	B. t. u.	
Nov. 10	78.03	45.09	32.94	2.91	Test 1
" 14	68.91	41.76	27.15	2.84	2

Average heat transmission 2″ coated Waterproof Lith, 2 tests 2.875 B. T. U.

Average heat transmission 1″ coated Waterproof Lith 5.75* B. T. U.

Hourly readings for each day from which the above summary was made will be furnished on application.

*On the assumption that the heat transmitted is proportional to the thickness.

QUINCY MARKET COLD STORAGE CO., BOSTON, MASS.
Insulated with Water-proof Lith

HEAT TRANSMISSION TEST ON UNION CORK BOARD

Two Inches in Thickness

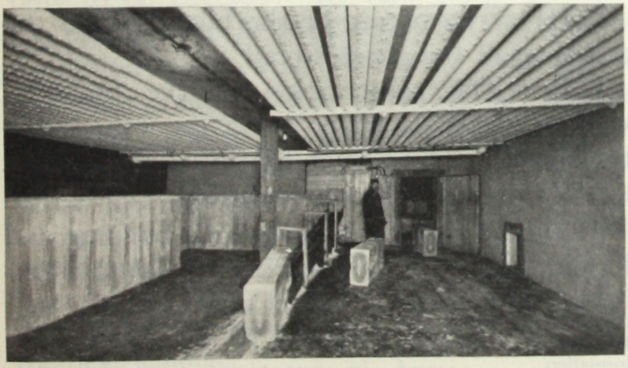
Date 1911		Average Temps. Outside	Inside	Range	B. t. u.	
Feb'y	17	69.08	44.14	24.94	3.48	Test 1
"	18	73.09	45.60	27.49	3.48	" 2
"	21	65.72	43.85	21.87	3.47	" 3
March	1	70.05	44.27	25.78	3.31	" 4
"	2	72.45	44.90	27.55	3.31	" 5

Average heat transmission 2″ Union Cork Board, 5 tests 3.41 B. T. U.

Average heat transmission 1″ Union Cork Board 6.82* B. T. U.

Hourly readings for each day from which the above summary was made will be furnished on application.

*On the assumption that the heat transmission is proportional to the thickness.



Minneapolis Artificial Ice and Cold Storage Co., Minneapolis, Minn. Insulated with Waterproof Lith.

CHAPTER XII.

PRACTICAL DETAILS FOR PLANNING AND ERECTING INSULATION

Important Factors in Cold Storage Construction

The following may be set down as factors to be considered in designing the insulation of any cold storage plant.

I. The average temperature of the locality; and also any very great variations from this average — throughout the middle part of the United States there is extremely hot summer weather which often endures for weeks.

II. The temperature to be maintained in the cold rooms.

III. The nature of the business and the character of the goods stored.

IV. The construction of the building; whether brick, stone or wood, as well as the thickness of the walls and floors.

V. The cost of refrigeration.

These factors vary with each building and locality and hence no complete rule as to thickness of insulation can be set down.

Thickness of Insulation to be used

The thickness of insulation to be used, in practice, depends upon cost in comparison with the econ-

ARMOUR NO. 2 BEEF HOUSE.
Lith on Walls.
Composition Cork on Floors (Union).

omy to be effected: In very warm climates, for example, it is good sense to use thicker insulation than that ordinarily erected for moderate temperatures, because the excessive heat coming in through the insulation puts greater burdens on the refrigerating machinery. When for any cause either ice or mechanical refrigeration is unusually expensive a thicker insulation is good practice. No amount of insulation stops the heat transmission entirely — the thicker the insulation, however, the smaller the heat leakage.

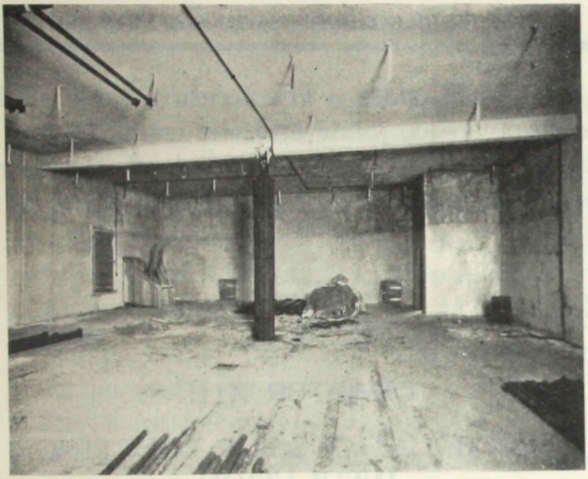
In the United States the following thick-

ARMOUR NO. 2 BEEF HOUSE, INTERIOR.

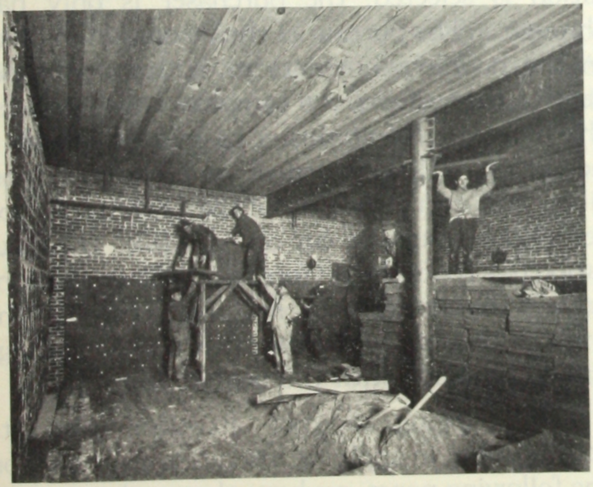
nesses of insulation are usually adopted to protect economically, rooms where the corresponding temperatures are to be maintained:

Temperatures Fahrenheit			Thickness of Water-proof Lith
Minus 15° to 5°	above zero		Six inches
5 to 20°	"	"	Five inches
20° to 35°	"	"	Four inches
35° to 45°	"	"	Three inches
45° and above			Two inches

For a freezing tank, there should be **five inches** of Water-proof Lith on the foundation, under the tank, and **six inches** of Water-proof



A Room at the Plant of the Fisher Artificial Ice and Cold Storage Company
Dubuque, Iowa.
Insulated with Waterproof Lith. Note Pillar Insulated with Beveled Lith.



Applying Waterproof Lith at the Plant of the Fisher Artificial Ice
Cold Storage Company, Dubuque, Iowa.

Lith on the sides. The freezing tank is the heart of an ice plant and the insulation of it should be generous enough to keep the brine as cold as possible.

CHAPTER XIII.

SPECIFICATIONS FOR ERECTING INSULATION

It is not to be forgotten that after the insulation is selected, the purchaser is only half through. The putting of the insulation in place in the building, amounts to at least fifty per cent of the value of the complete work, because the most careful attention to minute details is necessary. All joints must be as tight as possible, and every means for the entrance of external heat must be cut off. Indeed, the insulation of a room should form a complete envelope around the cooled space, and the junction of the wall insulation with the floors and ceilings should be made with the utmost care.

In bringing to your attention complete specifications in applying insulation as shown on the following pages, we hope that we have made

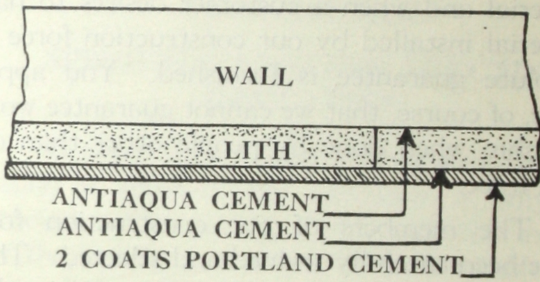
the subject sufficiently clear to permit of your installing the material satisfactorily. We want to again impress your mind with the necessity of properly installing this material and ask that you take advantage of the advice of our Engineering Department which is maintained to make clear any doubt you may have as to installing.

The Union Fibre Co. stands behind its material and when a customer desires to have material installed by our construction force an absolute guarantee is furnished. You appreciate, of course, that we cannot guarantee workmanship when done by people other than our own force.

The members of our construction force have been carefully trained and selected. They have made a study of construction and insulating problems.

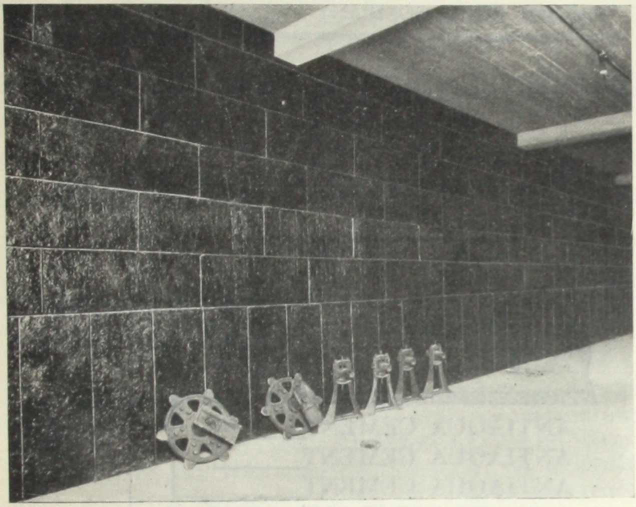
NOTE: Water-proof Lith or Union Cork may be interchanged in any specification in which either is named.

WALLS: Brick, Stone, Concrete, Concrete Block, Hollow Tile or Board.

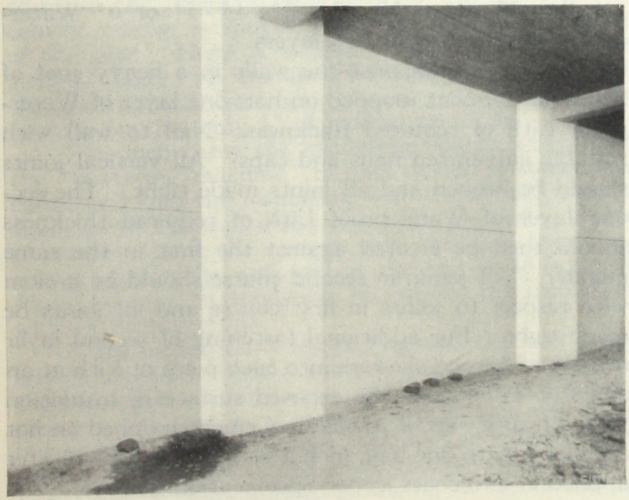


Specification No. 1. Single layer of $1\frac{1}{2}''$ – $2''$ or $3''$ Water-proof Lith or Union Cork Board.

Set directly against the walls in a heavy coat of Antiaqua Cement mopped on hot, one layer of Water-proof Lith of desired thickness. Nail to wall with suitable galvanized nails and caps. All vertical joints should be broken and all joints made tight. Coat the exposed surface of insulation with a heavy brush coat of Antiaqua Cement mopped on hot and finish with one-half inch Portland Cement plaster applied in two coats as per Specification No. A41.

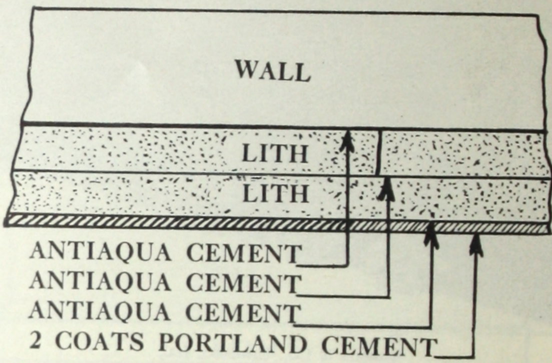


Morris & Co., Chicago, Ill.
Wall constructed as per Specification No. 3



Morris & Co., Chicago, Ill.
Showing Portland Cement Plaster finish

WALLS: Brick, Stone, Concrete, Concrete Block, Hollow Tile or Board.



Specification No. 3. 3″ - 4″ - 5″ or 6″ Water-proof Lith applied in two layers.

Set directly against the walls in a heavy coat of Antiaqua Cement mopped on hot, one layer of Water-proof Lith of required thickness. Nail to wall with suitable galvanized nails and caps. All vertical joints should be broken and all joints made tight. The second layer of Water-proof Lith of required thickness should then be erected against the first in the same manner. All joints in second course should be broken with respect to joints in first course and all joints be made tight. For additional fastening of second layer drive six 5″ wood skewers into each piece of Lith at an angle of 45°. Coat the exposed surface of insulation with a heavy coat of Antiaqua Cement mopped on hot and finish with one-half inch Portland Cement plaster applied in two coats as per Specification No. A41.

LITH APPLIED TO WALLS WITH PORTLAND CEMENT

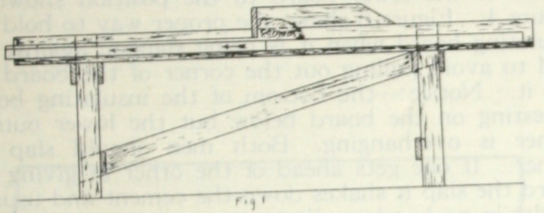


Fig 1

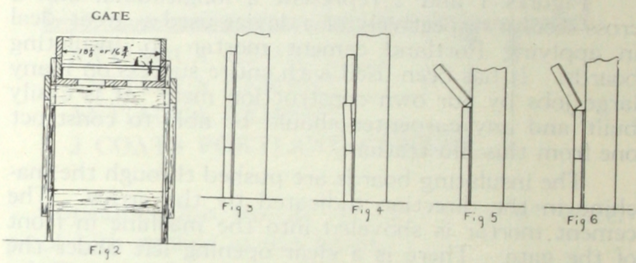
Figures 1 and 2 represent a longitudinal and a cross section respectively of a device used a great deal in applying Portland cement mortar to insulating boards. It has been used with entire success on many large jobs by our own construction men. It is easily built and any carpenter should be able to construct one from this illustration.

The insulating boards are pushed through the machine in the direction indicated by the arrow. The cement mortar is shoveled into the machine in front of the gate. There is a clear opening left under the gate ½″ high. As the insulating boards pass under the gate it holds back any cement that is above the opening leaving only ½″ of mortar on them.

Two men carry the insulating boards away from the "buttering machine" as this device is sometimes called and slap the insulation with the cement coated side against the wall where it is to be applied. If this is properly done the cement will hold the board securely against the wall and at the end of 48 hours it would be next to impossible to remove the insulation without destroying it.

If the insulation is slapped against the wall properly it should present a smooth and even surface on the exposed side as shown in figure 3. If it is not done properly the corners of some of the boards will hang out as in Figure 4. Figure 5 shows the cause of corners that hang out. The lower outside corner of the board that is being applied is resting on top of the in-

sulating board below. When the board is slapped against the wall it acts as a lever and pulls out the corner of the lower board to the position shown in Figure 4. Figure 6 shows the proper way to hold the insulating board when it is being slapped against the wall to avoid pulling out the corner of the board below it. Notice:—the bottom of the insulating board is resting on the board below but the lower outside corner is overhanging. Both men should slap together. If one gets ahead of the other in giving the board the slap it shakes down the cement and usually results in no bond at all.

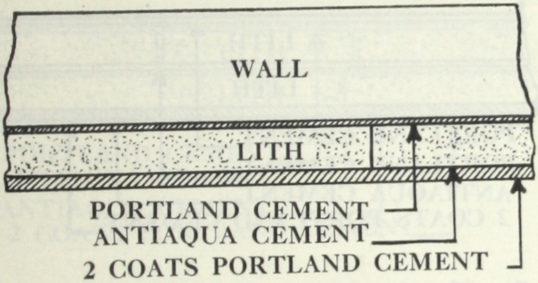


Sometimes trouble is experienced on account of the uneven surface of the wall to which the insulation is to be applied. If it is very uneven it should be plastered with Portland cement plaster before the insulation is applied.

Whenever it is possible spikes with galvanized washers under the heads are driven through the insulation into the wall. This is not absolutely necessary if you get a good bond, but many construction men do it as an additional safeguard against the insulation coming down. Sometimes it is impossible to drive the spikes into the walls. If that is the case put it up without them but watch your bond, see that the cement is holding every board snug against the wall and don't leave a single board until it is bonded in good shape.

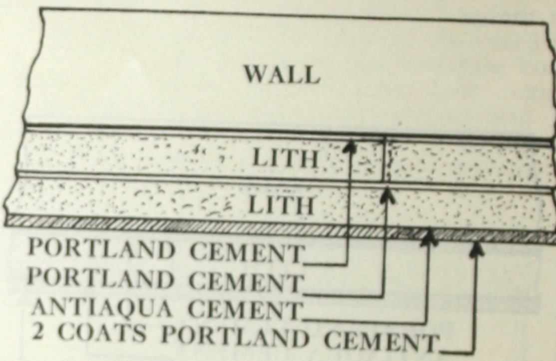
The mixture of Portland cement mortar used in applying the insulation consists of two parts clean sharp sand—free of clay and quicksand—and one part Portland cement. It should be about as stiff as mortar used in plastering.

WALLS: Brick, Stone, Concrete, Concrete Block or Hollow Tile.



Specification No. 2. Set directly against the walls in a bed of $\frac{1}{2}''$ Portland Cement Mortar, mixed in proportion of one part Portland Cement to two parts clean, sharp sand, one layer of Water-proof Lith of desired thickness. Nail to wall with suitable galvanized nails and caps. All joints should be broken and all joints made tight. No cement should be allowed in the joints. Coat the exposed surface of insulation with a heavy brush coat of Antiaqua Cement mopped on hot and finish with one half inch Portland Cement plaster applied in two coats as per Specification No. A41.

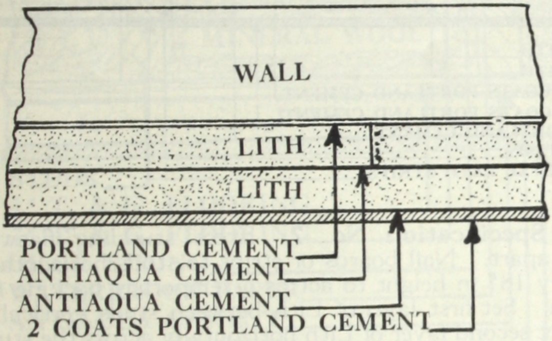
WALLS: Brick, Stone, Concrete, Concrete or Hollow Tile.



Specification No. 4. 3″ - 4″ - 5″ or 6″ Water-proof Lith applied in two layers.

Set directly against the walls, one layer of Water-proof Lith of required thickness, erected in a half inch bed of Portland Cement Mortar mixed in the proportion of one part Portland Cement to two parts clean, sharp sand. Nail to wall with suitable galvanized nails and caps. All vertical joints should be broken and all joints made tight. No cement should be allowed in the joints. The second course of Water-proof Lith Board of required thickness should then be erected to the first course in the same manner. All joints should be broken with respect to the first course and all joints made tight. For additional fastening of second course drive six 5″ wood skewers into each piece of Lith at an angle of 45°. Coat the exposed surface of insulation with a heavy coat of Antiaqua Cement mopped on hot and finish with one-half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

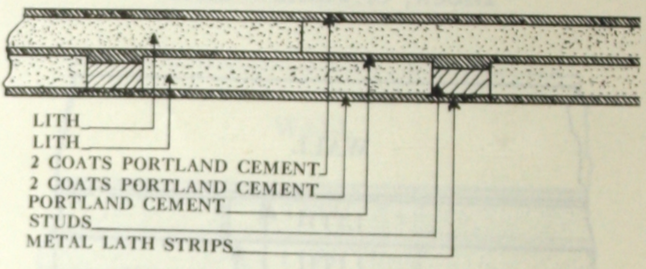
WALLS: Brick, Stone, Concrete, Concrete Block, or Hollow Tile.



Specification No. 5. Two layers insulation.

Set directly against the walls in a half inch bed of Portland Cement Mortar, one layer of Water-proof Lith of required thickness. All vertical joints should be broken and all joints made tight. Nail to wall with suitable galvanized nails and caps. Erect to this in hot Antiaqua Cement, a second layer of Water-proof Lith of required thickness. All joints in the second layer should be broken with respect to the joints in first layer and all joints be made tight. For additional fastening of the second layer drive six 5″ wood skewers through each piece of Lith at an angle of 45°. Coat exposed surface of insulation with a heavy brush coat of Antiaqua Cement mopped on hot and finish with half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

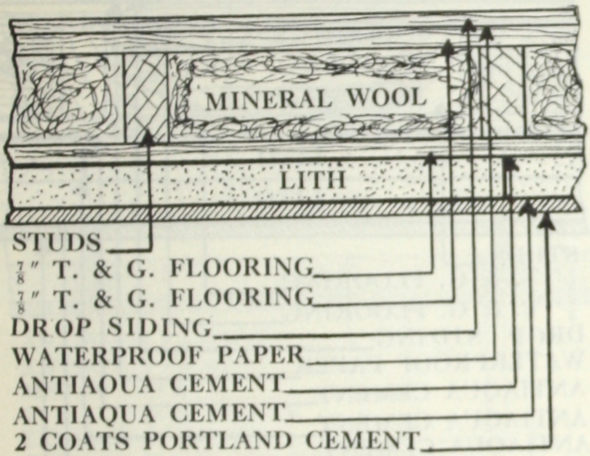
WALLS: Frame Construction.



Specification No. 7. Erect studding flatwise 18″ apart. Nail boards or strips to studs horizontally every 18″ in height to act as a temporary backing for Lith. Set first layer of Lith between studs vertically. Erect second layer of Lith horizontally across the studs bedded in ½″ Portland cement mortar mixed in the proportion of two parts clean sharp sand to one part Portland cement breaking all vertical joints. As additional fastenings for second layer of Lith drive two 20-D spikes fitted with galvanized washers under the heads through the Lith into each stud and fasten second layer of Lith to first layer with wood skewers 5″ long driven at an angle of 45° wherever necessary. With a trowel take cement mortar and fill up holes between studs and second layer of Lith. Remove strips or boards acting as a temporary backing. Fill up all cracks in insulation with pulverized Lith. Nail strips of metal lath to surface of studs where exposed. Coat both sides of wall with Antiaqua cement and finish with two coats of Portland cement plaster as per specification No. A41.

NOTE: Antiaqua cement may be used between the two layers of Lith if desired. If Antiaqua cement is used sufficient ¼″ x 3⅝″ strips of Fibrofelt should be ordered to nail over the studs to bring the surface out flush with the face of the first layer of Lith.

WALLS: Frame Construction.



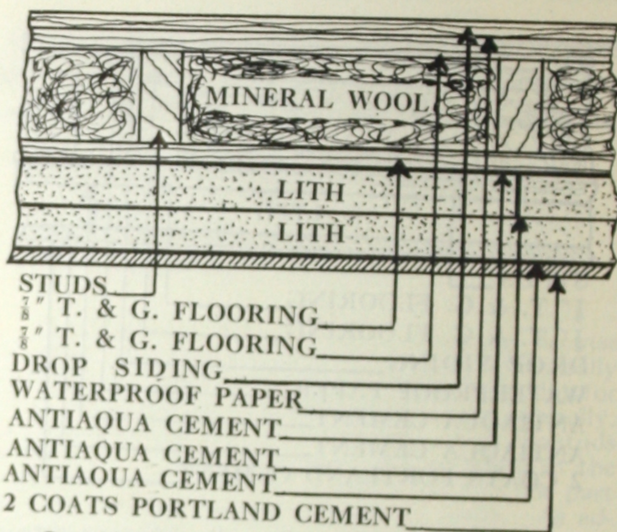
Specification No. 6. On walls of frame construction, single layer of 1½″ - 2″ or 3″ Water-proof Lith.

Set directly against the sheathed studding in a heavy coat of Antiaqua Cement mopped on hot, one layer of Water-proof Lith of required thickness. All vertical joints should be broken and all joints made tight. Nail to wall with suitable galvanized nails and caps. Coat the exposed surface of insulation with a heavy coat of Antiaqua Cement mopped on hot and finish with half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

NOTE: Waterproof paper can be used instead of Antiaqua Cement between Lith and boards if desired.

NOTE: If it is desired to fill the space between the studding, use Rock Wool well packed in place.

WALLS: Frame Construction.

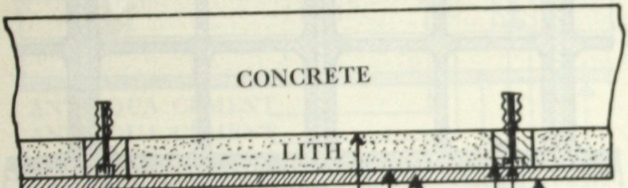


Specification No. 8. Frame construction, double insulation, 3″ - 4″ - 5″ or 6″ thick.

Apply to sheathed studding as per Specification No. 6 one layer of Water-proof Lith of required thickness. Nail to wall with suitable galvanized nails and caps. Apply to first layer in a heavy coat of Antiaqua Cement mopped on hot, a second layer of Water-proof Lith of required thickness. All joints in second layer should be broken with respect to joints in first layer. Coat the exposed surface of insulation with a heavy coat of Antiaqua Cement mopped on hot and finish with a half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

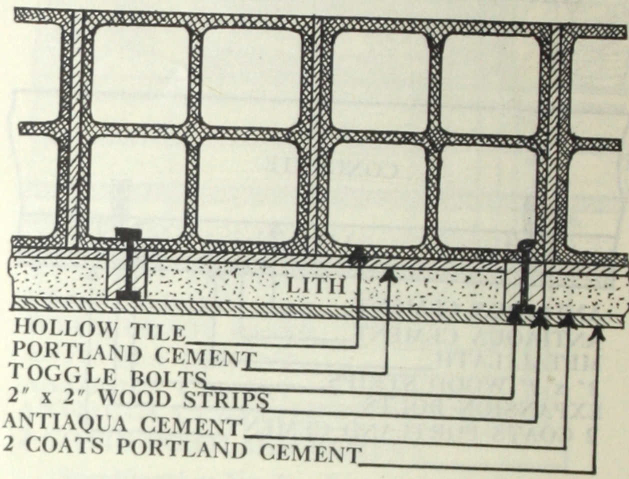
NOTE: If it is desired to fill the space between the studding, use Rock Wool well packed in place.

CEILINGS: Concrete or Hollow Tile. Single layer of Water-proof Lith, any thickness.



Specification No. 9. Apply direct to ceiling in a heavy coat of Antiaqua Cement mopped on hot, a layer of 2″ Water-proof Lith set between 2 x 2 strips spaced 18″ apart. The 2 x 2 strips should be fastened with suitable expansion or toggle bolts. Coat exposed surface of insulation with a heavy coat of Antiaqua Cement mopped on hot. Finish with expanded metal lath and one half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

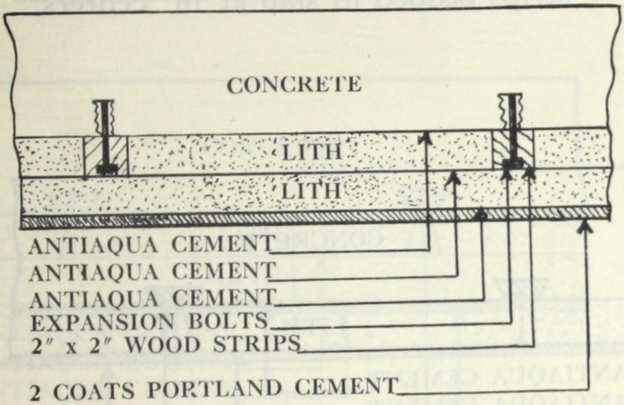
CEILINGS: Hollow Tile.



Specification No. 10. Single layer of Water-proof Lith, any thickness.

Apply direct to ceiling in a half inch bed of Portland Cement Mortar, a layer of 2″ Water-proof Lith set between strips spaced 18″ apart. The strips should be fastened with suitable toggle bolts. Coat exposed surface of insulation with a heavy coat of Antiaqua Cement mopped on hot. Finish with expanded metal lath and one-half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

CEILINGS: Concrete or Hollow Tile.

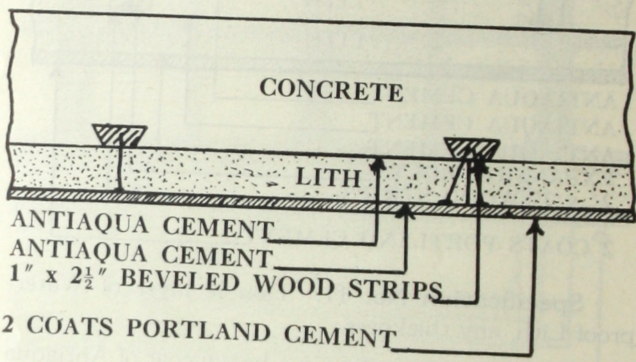


Specification No. 11. Double layer of Water-proof Lith, any thickness.

Apply direct to ceiling in a heavy coat of Antiaqua Cement mopped on hot, a layer of 2″ Water-proof Lith set between 2 x 2 wood strips painted with Antiaqua and spaced 18″ apart. Apply without strips between in Antiaqua Cement mopped on hot a second layer of 2″ Water-proof Lith, crossing the first layer at right angles. Nail second layer to strips with suitable galvanized nails and caps. Coat exposed surface of insulation witha heavy coat of Antiaqua Cement mopped on hot. Finish with one-half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

NOTE: Where wood strips are inserted in ceiling insulation, a board finish can be applied if desired instead of plaster finish.

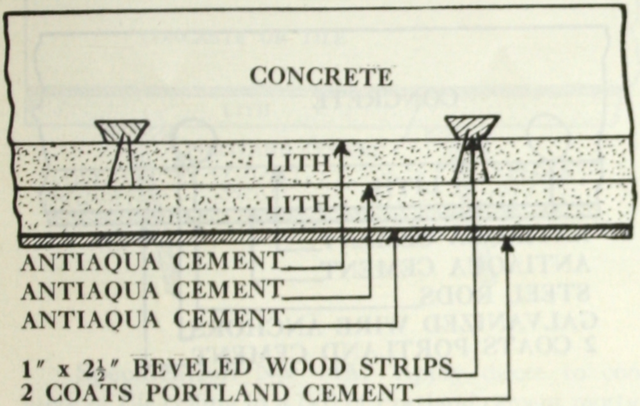
CEILINGS: Concrete with 1 x 2½″ bevelled strips bedded in slab at 16″ centers.



Specification No. 12. Single layer Water-proof Lith, any thickness.

Apply direct to ceiling in a heavy coat of Antiaqua Cement, one layer of Water-proof Lith of required thickness. Nail securely to strips with galvanized nails and caps. Finish with one-half inch Portland Cement Plaster in two coats as per Specification No. A41.

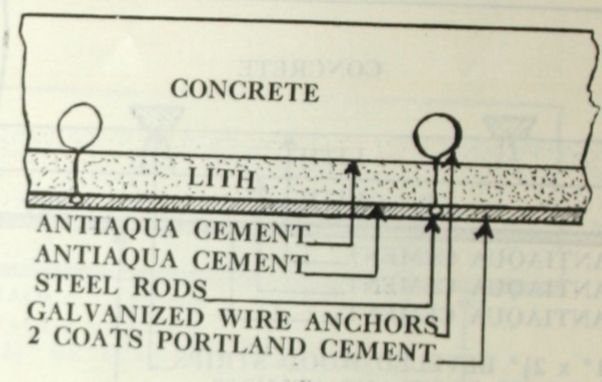
CEILINGS: Concrete with 1″ x $2\frac{1}{2}$″ beveled strips bedded in slab at 16″ centers.



Specification No. 13. Double layer Water-proof Lith, any thickness.

Apply first layer of Water-proof Lith of required thickness, direct to ceiling as per Specification No. 9. At right angles to first layer, apply a second layer of Water-proof Lith of required thickness in a heavy coat of Antiaqua Cement and set between Antiaqua coated wood strips 2 x 2 spaced 18″ apart. Nail second layer to first with suitable galvanized nails and caps. Coat exposed surface of insulation with a heavy coat of Antiaqua Cement mopped on hot and finish with one-half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

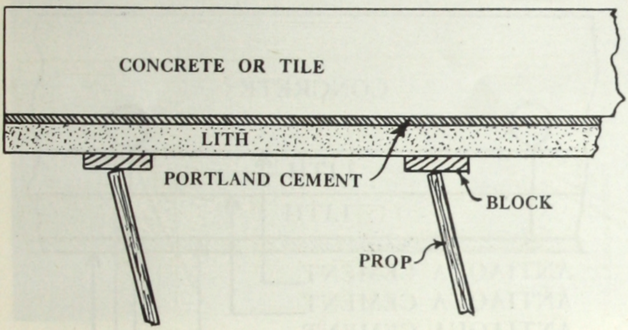
CEILINGS: Concrete. Single layer of Lith laid in concrete forms.



Specification No. 14. The concrete forms shall be constructed three inches deeper than would ordinarily be necessary. In these forms place one layer of 3″ Water-proof Lith, the underside of each slab coated with Antiaqua Cement. Between the courses of Lith board, place galvanized wire anchors spaced 18″ apart, the loop of the anchor extending above surface of insulation. Flood surface of insulation with Antiaqua Cement to receive concrete. When forms are removed, fasten steel rods to lower ends of wire anchors and finish with Portland Cement Plaster applied in two coats as per Specification No. A41.

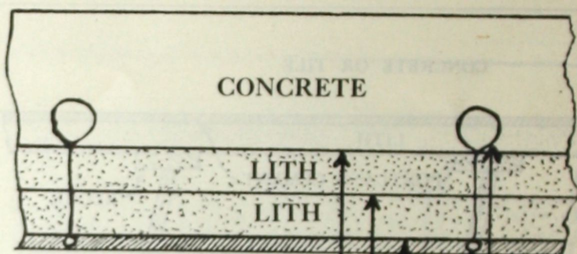
NOTE: Water-proof Lith of any thickness may be installed in this way.

On Ceiling bedded in Portland Cement Mortar.



Specification No. 14A. Apply direct to concrete or tile ceiling in a bed of Portland cement mortar mixed in the proportion of two parts clean sand to one part Portland cement not more than ½" in thickness a layer of Water-proof Lith (any desired thickness) breaking transverse joints between the Lith. Prop Lith against ceiling with ⅞" x 4"-6" boards any length necessary placing a block of wood large enough to prevent punching holes in Lith on top of each board. Use from 3 to 6 props under each piece of Lith leaving them in place 48 hours. Fill up cracks and holes in the insulation with pulverized Lith. (A second layer of Lith may then be applied in the same manner if desired all joints in the second layer being broken with respect to the joints in the first.). Coat the underside of insulation with Antiaqua cement and finish with two coats of Portland cement plaster as per specification No. A41.

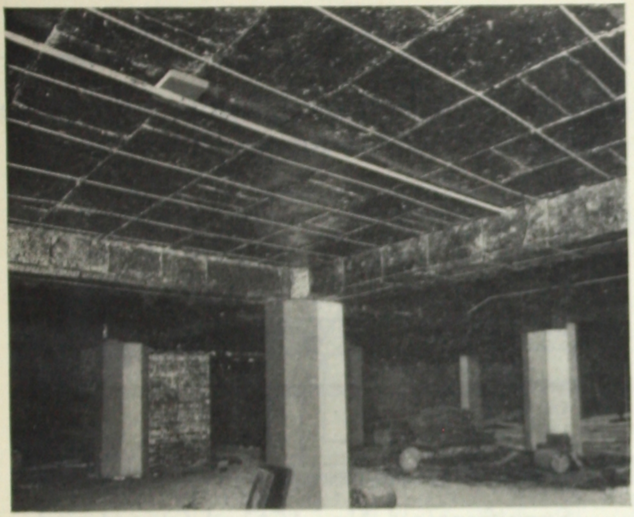
CEILINGS: Concrete. Two layers of Water-proof Lith laid in concrete forms.



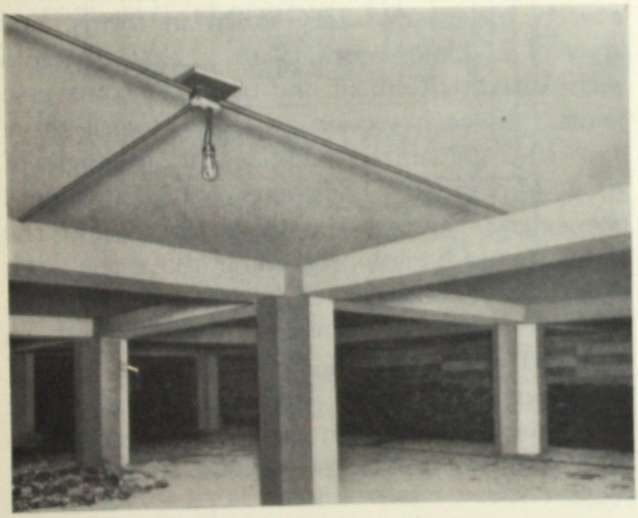
Specification No. 15. The concrete forms shall be constructed 4½″ deeper than would ordinarily be necessary. In these forms place one layer of 2″ Water-proof Lith as per Specification No. 14, spacing the anchors 18″ apart. Put down a second layer of 2″ Water-proof Lith in a heavy bed of hot Antiaqua Cement. Break all joints in second layer with respect to joints in first layer. Flood with heavy coat of Antiaqua Cement to receive concrete. When forms are removed, fasten steel rods to lower ends of wire anchors and finish with Portland Cement Plaster as per Specification No. A41.

NOTE: The loop of each wire anchor shall extend above top surface of Lith boards to engage concrete.

NOTE: Two layers of Water-proof Lith of any thickness may be installed in this way.

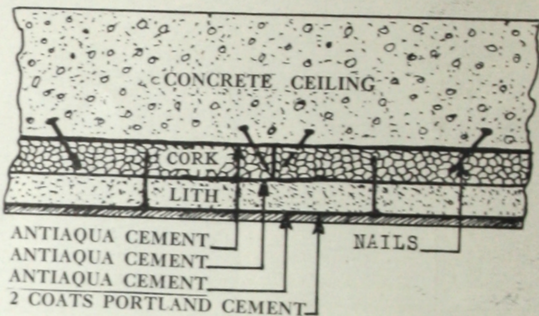


Morris & Co., Chicago, Ill.
Ceiling Insulation of Water-proof Lith as per specification No. 15



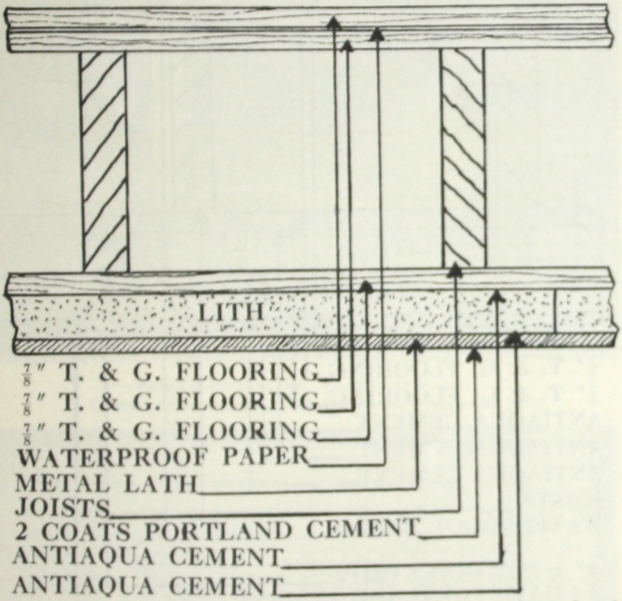
Morris & Co., Chicago, Ill.
Showing Portland Cement Plaster finish on ceiling shown above.

CEILINGS: Concrete.—Insulation to be laid in concrete forms.



Specification No. 15A. Make the concrete forms two inches deeper than would otherwise be necessary. Lay down in forms, one layer of 2″ Union Cork Board. Seal all joints with Antiaqua Cement and break all transverse joints. In each section of Cork Board, drive four 20-d galvanized nails set at an angle of about 45 degrees. The points of the nails should not extend through the Cork Board and the heads should be left protruding above the Cork Board so that they will engage the concrete when poured. After concrete forms have been removed, apply to Cork Board, a single layer of 2″ Water-proof Lith in Antiaqua Cement in the usual manner and finish with two coats of Portland Cement plaster as per Specification No. A41.

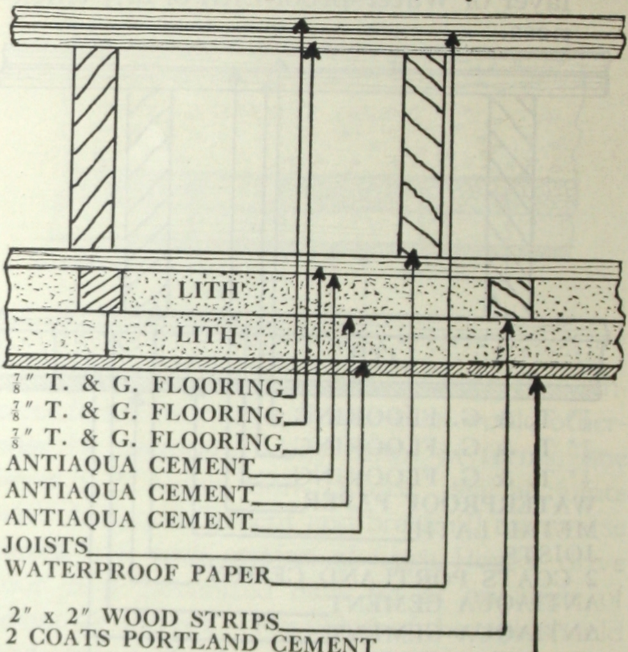
CEILINGS: Frame construction. Single layer of Water-proof Lith of any thickness.



Specification No. 16. Apply to sheathed ceiling a layer of Water-proof Lith of required thickness set in hot Antiaqua Cement. Nail firmly in place with suitable galvanized nails and caps. Coat exposed surface with hot Antiaqua Cement. Finish with one-half inch Portland Cement Plaster as per Specification No. A41.

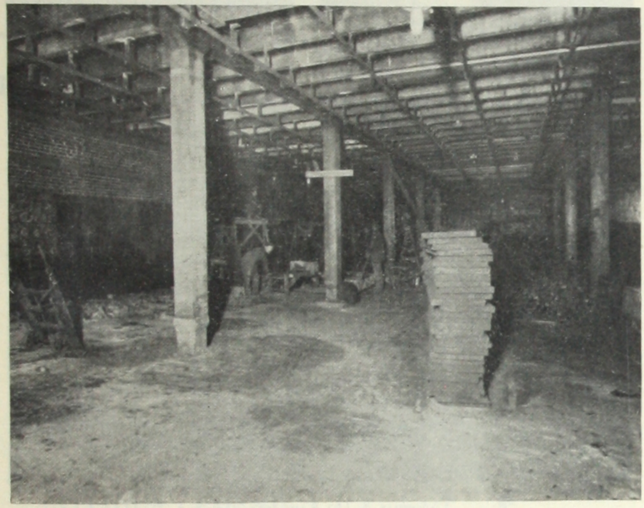
NOTE: Two layers of insulating paper instead of Antiaqua Cement may be used next to ceiling boards.

CEILINGS: Frame Construction. Double layer of Water-proof Lith, any thickness.

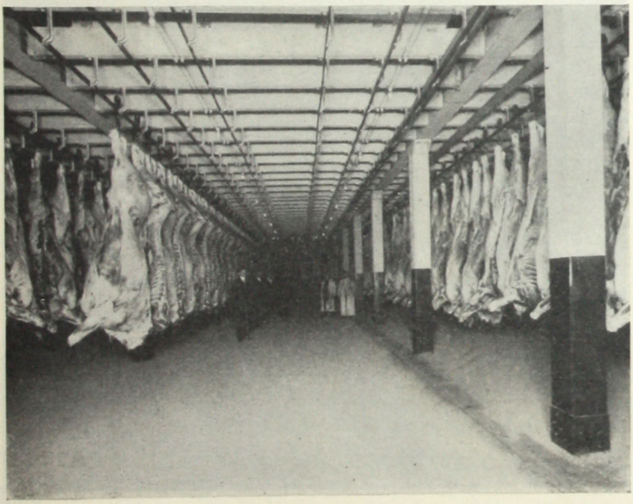


Specification No. 17. Apply to sheathed ceiling a layer of Water-proof Lith of the required thickness set in hot Antiaqua cement with wood strips between each row of Lith. Nail Lith and wood strips securely in place using galvanized caps on nails in Lith. It is preferred to run wood strips at right angles to ceiling joists spiking thru the strips into the joists instead of as shown in cut above. Apply second layer of Water-proof Lith of required thickness to first layer set in hot Antiaqua cement running the Lith at right angles to the first layer nailing it securely to wood strips in first layer with nails and galvanized caps. Coat exposed surface with Antiaqua cement and finish with two coats of Portland cement plaster as per specification No. 41A.

Note: Insulating Paper in one or more thicknesses may be used next to sheathing boards instead of Antiaqua cement if desired.

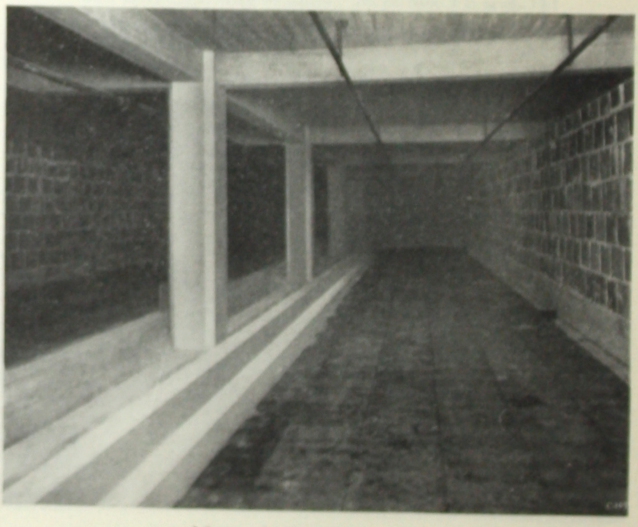


Armour Packing Co., Kansas City, Mo.
In Course of Construction. Insulated with Water-proof Lith



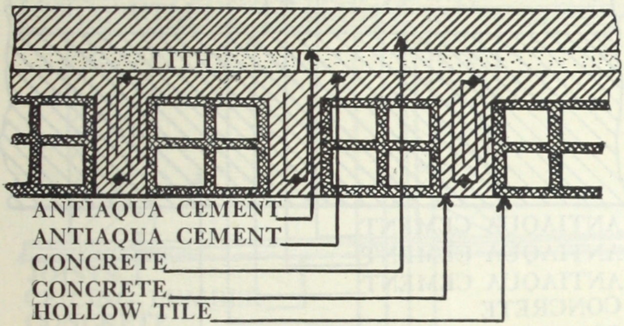
Armour Packing Co., Kansas City, Mo.
Insulated with Water-proof Lith

Morris & Co.,Chicago, Ill.
Showing floor insulation of Water-proof Lith as per specification No. 19



Morris & Co., Chicago, Ill.
Showing floor insulation of Water-proof Lith in coil bunkers as per specification 18

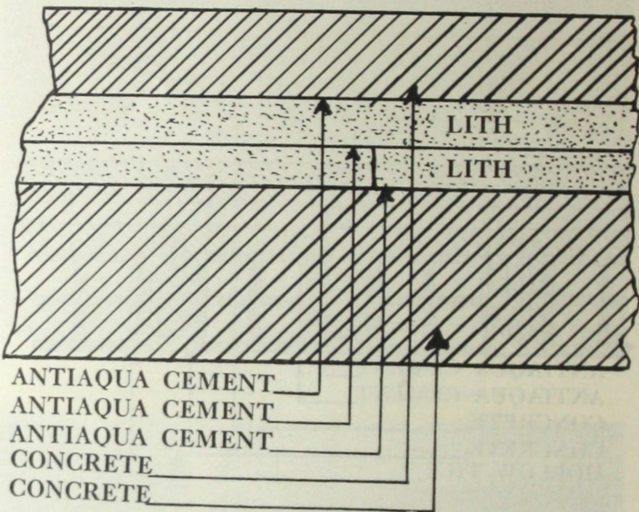
FLOORS: Concrete or Hollow Tile.



Specification No. 18. Single layer Water-proof Lith, any thickness. Concrete finish.

Lay down in hot Antiaqua Cement a course of Water-proof Lith of required thickness. Break all transverse joints and make all joints tight. Flood the top surface with hot Antiaqua Cement and finish with 4″ concrete working floor.

FLOORS: Concrete or Hollow Tile.

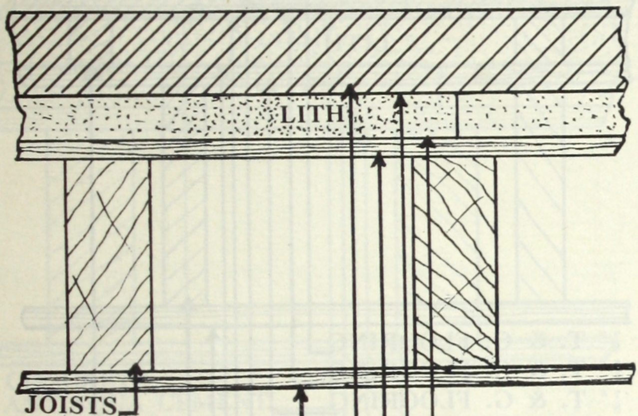


Specification No. 19. Double layer Water-proof Lith, any thickness. Concrete finish.

Lay down in hot Antiaqua Cement, a course of Water-proof Lith of required thickness. Upon this lay in hot Antiaqua Cement, a second course of Water-proof Lith of required thickness. Break all joints in second course with respect to joints in first course. Make all joints tight. Flood the top surface with hot Antiaqua Cement and finish with 4″ concrete working floor.

NOTE: If board finish is desired instead of concrete, embed 2 x 2 strips 18″ apart in top layer of insulation to receive wood flooring finish.

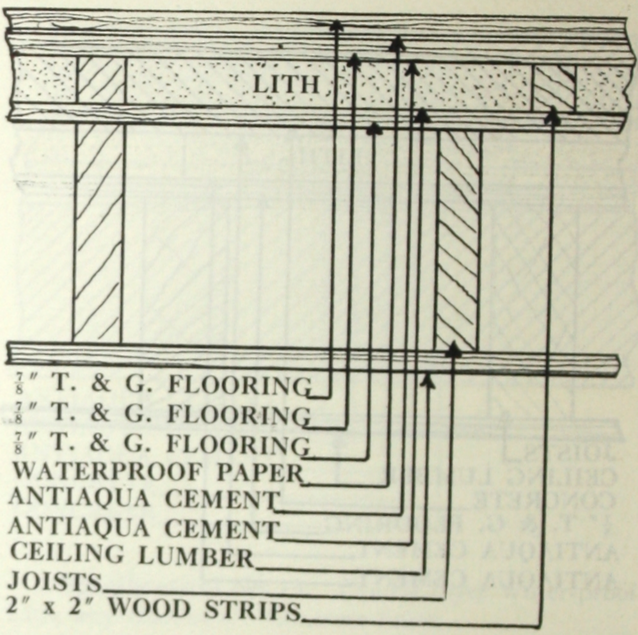
FLOORS: Frame Construction.



Specification No. 20. Single layer Water-proof Lith, any thickness. Concrete finish.

On the board flooring, lay down in hot Antiaqua Cement, one course of Water-proof Lith of required thickness. Break all transverse joints and make all joints tight. Flood the top surface with hot Antiaqua Cement and finish with 4″ Concrete working floor.

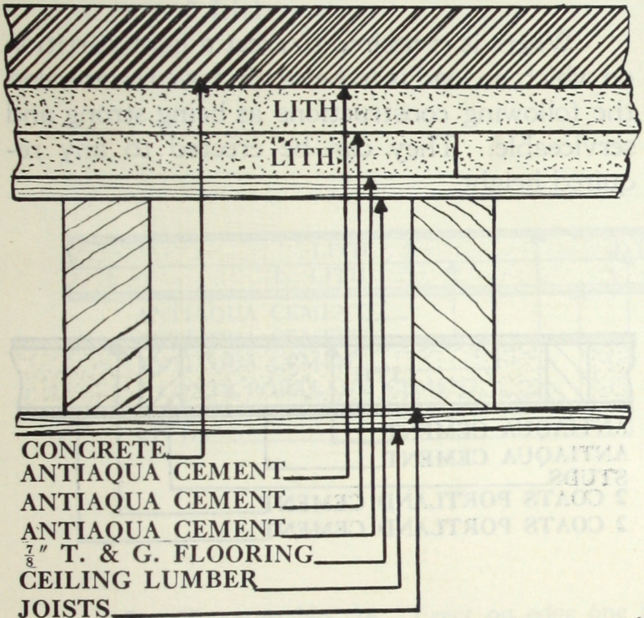
FLOORS: Frame Construction.



Specification No. 21. Single layer Waterproof Lith, any thickness. Board finish.

On the board flooring lay down in hot Antiaqua Cement, one course of Water-proof Lith of required thickness between wood strips spaced 18″ apart. They may be spaced 36″ apart. Flood the top surface with hot Antiaqua Cement and finish with board working floor as desired.

FLOORS: Frame Construction.



Specification No. 22. Double layer Water-proof Lith, any thickness. Concrete finish.

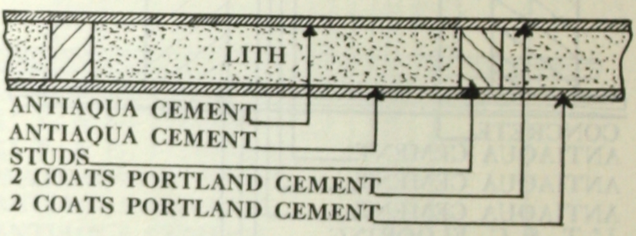
On the board flooring, lay down in hot Antiaqua Cement, one course of Water-proof Lith of required thickness. Upon this lay in hot Antiaqua Cement, a second course of Water-proof Lith of required thickness. Break all joints in second course with respect to joints in first course. Make all joints tight. Flood the top surface with hot Antiaqua Cement and finish with 4″ concrete working floor.

NOTE: If board finish is desired instead of concrete, embed strips 18″ apart in top layer of insulation to receive wood flooring finish.

NOTE: For pipe loft floors, apply two layers insulating paper, then lay insulation in hot Antiaqua Cement, cover with Insuloid paper, seams well lapped, then flood with Antiaqua Cement ⅛″ deep.

PARTITIONS:

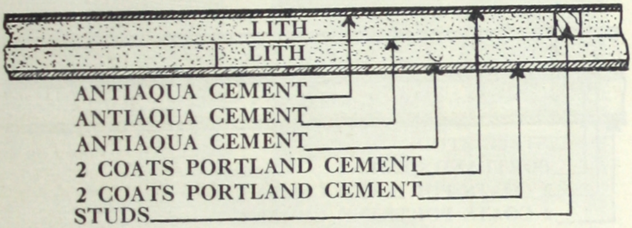
Where it is desired to erect a light partition on which no load is to be carried, we recommend the following constructions as being strong and serviceable. They can be erected to any required height.



PARTITIONS: Single layer 3″ Water-proof Lith.

Specification No. 23. Erect on edge a layer of 3″ Water-proof Lith set between 2″ x 3″ studs spaced 18″ apart. They may be 48″ apart. Coat all edges of Lith boards with hot Antiaqua Cement as they are erected. Toe nail edges of boards in studding. Coat both sides with hot Antiaqua Cement and finish with half inch Portland Cement Plaster as per Specification No. A41.

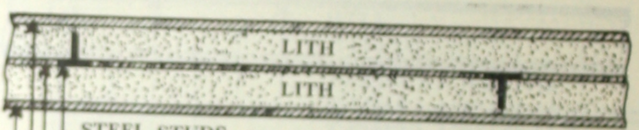
PARTITIONS: Two layers of 2″ Water-proof Lith.



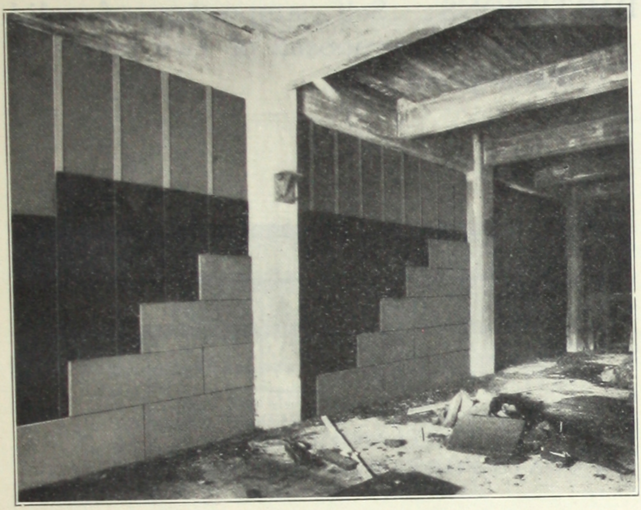
Specification No. 24. Erect on edge one layer of 2″ Water-proof Lith as per Specification No. 23, set between 2″ x 2″ studs spaced 48″ apart. To one side of this partition erect on edge, a second layer of 2″ Water-proof Lith set in hot Antiaqua Cement. Break all joints in second layer with respect to joints in first layer. Coat both sides of partition with hot Antiaqua Cement and finish with half inch Portland Cement Plaster as per Specification No. A41.

NOTE: The above partition can be erected in any thickness desired, using one layer of 2″ and one layer of 3″ Lith or two layers of 3″ Lith.

PARTITIONS: Solid Lith Re-inforced with Steel T Irons.



Specification No. 25. Where space must be economized and an especially strong insulated partition is desired, we recommend the following construction: Erect 2″ x 2″ steel T's vertically at 24″ centers as per the attached sketch. Then erect between these T's two layers of 2″ Lith in Portland Cement Mortar. Finish both sides with ½″ Portland Cement Plaster as per Specification No. A41.

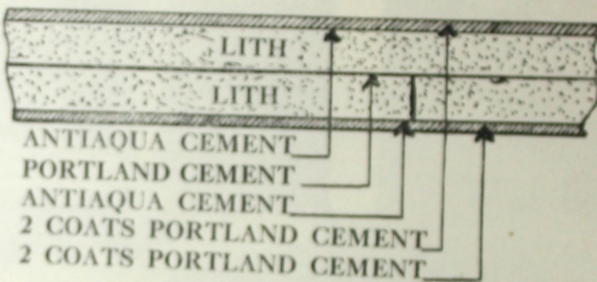


Dubuque Packing Company, Dubuque, Iowa
Showing partition insulation of Water-proof Lith as per specification No. 25

PARTITIONS: Brick, Stone, Concrete or Hollow Tile.

Specification No. 26. Any of the above types of partition may be insulated with Water-proof Lith according to Specification Nos. 1 to 5 for wall insulation.

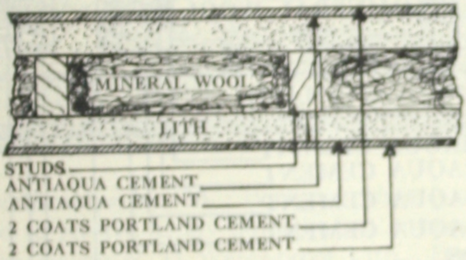
PARTITIONS: Self-supporting of solid insulation composed of two layers of Water-proof Lith.



Specification No. 27. Erect on edge, one layer of 2″ Water-proof Lith. Coat all edges with hot Antiaqua Cement as the sections are set in place. Break all vertical joints. Erect a second layer of 2″ Water-proof Lith to the first layer in a bed of ½″ Portland Cement Mortar. Break all joints in second layer with respect to joints in first layer. Coat both exposed sides of insulation with hot Antiaqua Cement and finish with one half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

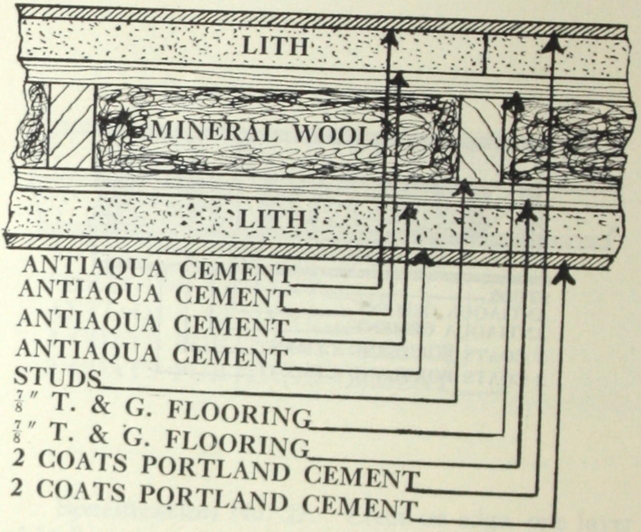
NOTE: The above type of partition can be erected in any thickness desired, using one layer of 2″ and one layer of 3″ or two layers of 3″ Water-proof Lith.

PARTITIONS: Frame Construction.



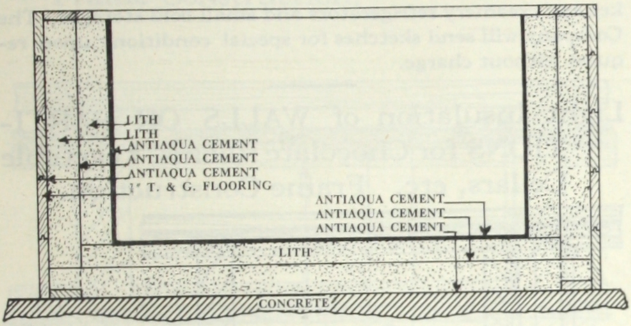
Specification No. 28. Apply directly against both sides of 2″ x 4″ studding erected on 16″ centers, a layer of Water-proof Lith of required thickness. Break all vertical joints. Make all joints tight. Fill the space between studs with Rock Wool well packed in place. Coat exposed surface of insulation with Anti-aqua Cement mopped on hot and finish with half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

PARTITIONS: Frame Construction.



Specification No. 29. Erect 2" x 4" studding at 18" centers. Sheath both sides with $\frac{7}{8}$" T & G boards. Fill space between studding with Rock Wool well packed. Apply to sheathing on both sides of partition, a course of Water-proof Lith of required thickness set in hot Antiaqua Cement and nailed to sheathing with suitable galvanized nails and caps. Break all vertical joints. Make all joints tight. Coat exposed surface of insulation with Antiaqua Cement mopped on hot and finish with half inch Portland Cement Plaster applied in two coats as per Specification No. A41.

FREEZING TANKS:

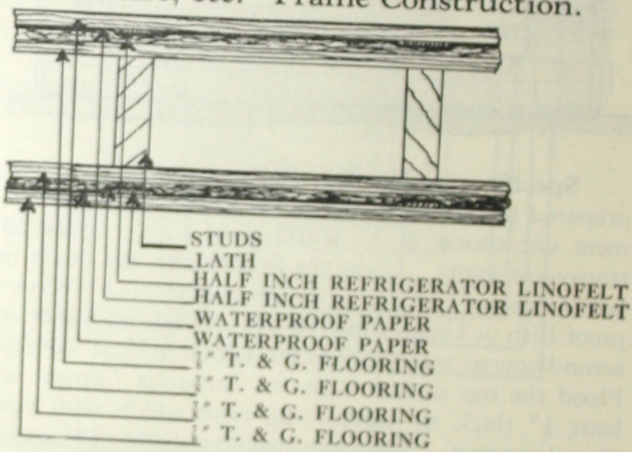


Specification No. 30. Bottom: Upon level base prepared to receive it, lay down in hot Antiaqua Cement one course of 3″ Water-proof Lith. Break all transverse joints. Upon the first course, lay down in hot Antiaqua Cement a second course of 2″ Water-proof Lith or Union Cork Board. Break all joints in second course with respect to joints in first course. Flood the top surface with hot Antiaqua Cement at least ⅛″ thick to receive the tank which shall rest directly upon it. The space insulated shall be 12″ wider and 12″ longer than the outside dimensions of the tank.

Specification No. 30A. Sides: Apply direct to sides of tank one course of 3″ Water-proof Lith set in hot Antiaqua Cement. To the first course apply a second layer of 3″ Water-proof Lith in hot Antiaqua Cement set between 2″ x 3″ upright wood studs spaced 36″ apart. Coat exposed surface of insulation with hot Antiaqua Cement and finish with ⅞″ T & G flooring. Protect exposed top surface of insulation around tank with ⅞″ T & G flooring in the same manner.

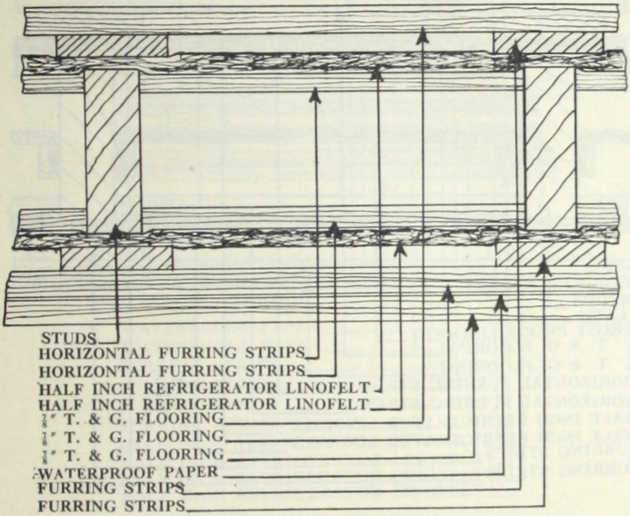
The specifications which follow—31 to 40—show light insulation designs suitable for ice storage houses, meat market and creamery refrigerators and small cold storages. The Company will send sketches for special conditions upon request without charge.

Light Insulation of WALLS OR PARTITIONS for Chocolate Rooms, Vegetable Cellars, etc. Frame Construction.



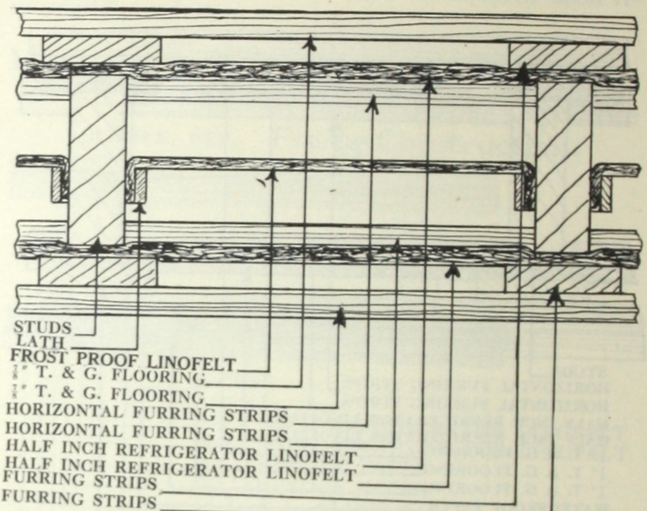
Specification No. 31. Where a light insulation is desired on a frame wall or partition, we recommend the following: To both sides of studding, erect $\frac{7}{8}''$ T & G boards. On this sheeting place one layer of $\frac{1}{2}''$ Refrigerator Linofelt. Cover with one thickness of waterproof paper lapped two inches. Fasten in place with lath nailed over face of studs vertically, then finish both sides with $\frac{7}{8}''$ T & G lumber of proper quality.

ICE HOUSE WALL OR PARTITION:
Frame Construction.



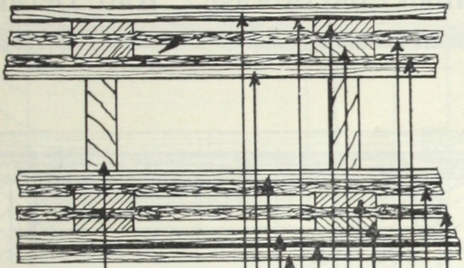
Specification No. 32. Set furring strips horizontally between studs on both sides, at 36" centers. Erect to face of studs on both sides, one layer ½" Refrigerator Linofelt. Strip both sides of studs with ⅞" x 4" furring strips, finish outside wall with one layer ⅞" T & G boards and finish inside of wall with two layers ⅞" T & G boards with water-proof paper between.

ICE HOUSE WALL OR PARTITION:
Frame Construction.



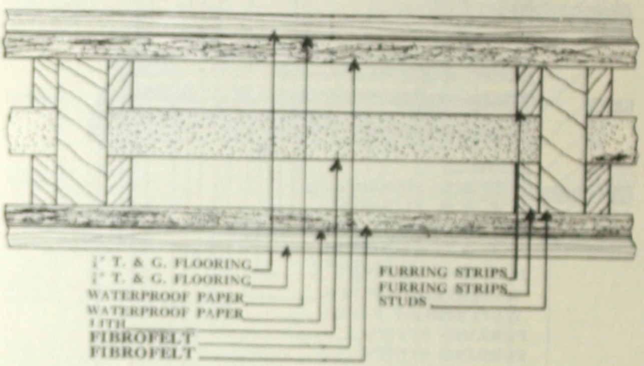
Specification No. 33. Between studs erected on 16″ centers, place one layer Frost Proof Linofelt, flashing the edges against the studs and fastening in place with lath well nailed. Set flush with face of studs on both sides, 1″ x 4″ strips horizontally at 36″ centers. On both sides of studs erect one thickness of ½″ Refrigerator Linofelt. Strip both faces of studs vertically with ⅞″ x 4″ furring strips, then finish with ⅞″ T & G flooring.

ICE HOUSE WALLS: Frame Construction.



Specification No. 34. Sheet both sides of studs with one layer $\frac{7}{8}''$ T & G boards. To this sheathing, apply one layer $\frac{1}{2}''$ Refrigerator Linofelt. Strip vertically over face of studs with $\frac{7}{8}''$ x $4''$ furring strips. Set $\frac{7}{8}''$ x $4''$ furring strips horizontally between these strips at $36''$ centers. Follow with a second layer of $\frac{1}{2}''$ Refrigerator Linofelt and furring strips as before. Finish inside of walls with two layers $\frac{7}{8}''$ T & G boards with water-proof paper between and finish outside of walls with water-proof paper and one layer $\frac{7}{8}''$ T & G boards.

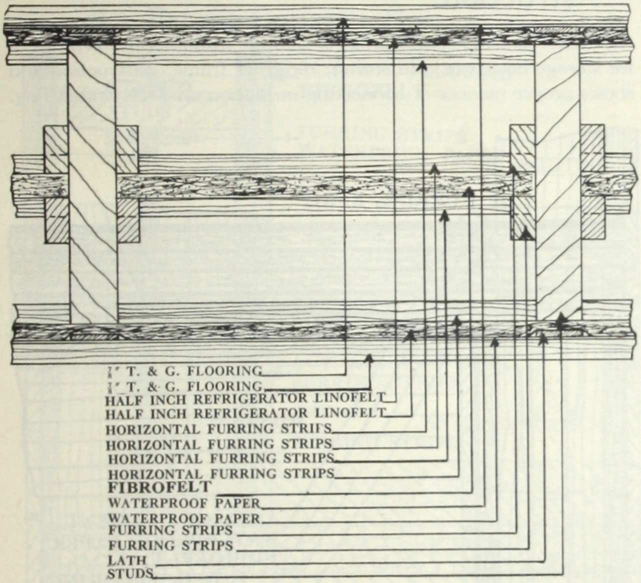
INSULATION for Ice Storage, Creamery or Small Cold Storage. Wall Detail.



Specification No. 35. Between 2″ x 6″ studs set 18″ apart, erect one layer 2″ Lith. Strip both edges with 1″ x 2″ strips according to sketch. Apply direct to both faces of studs, one layer of 1″ Fibrofelt. Cover with two layers of water-proof paper, edges well lapped and finish with $\frac{7}{8}$″ T & G flooring.

Note: Fibrofelt may be used in place of Lith to go between studs and is applied in the same manner.

ICE HOUSE INSULATION: Wall Detail.



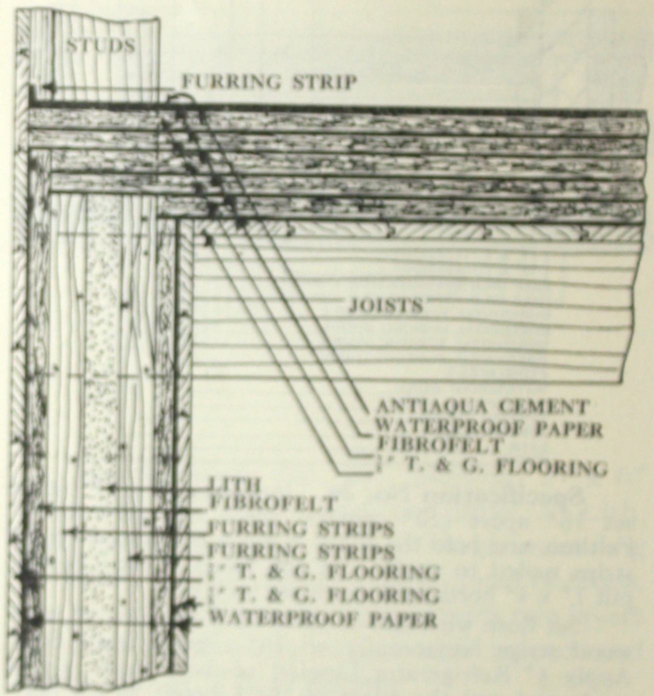
Specification No. 36. Between 2″ x 12″ studs set 18″ apart (20″ centers) place one layer of 1″ Feltlino, and hold the edges in place by vertical wood strips nailed to studs. At the joints of the Fibrofelt put 1″ x 4″ horizontal strips on each side.

Set flush with face of studs on both sides 1″ x 4″ wood strips horizontally on 36″ centers from floor. Apply ½″ Refrigerator Linofelt on both faces of the studs and nail the edges of the Linofelt to the horizontal strips with roofing nails.

Nail lath over the Linofelt vertically on face of studs. Then apply on inside and outside of wall, two layers of water-proof paper, edges well lapped and finish with ⅞″ T. & G. flooring.

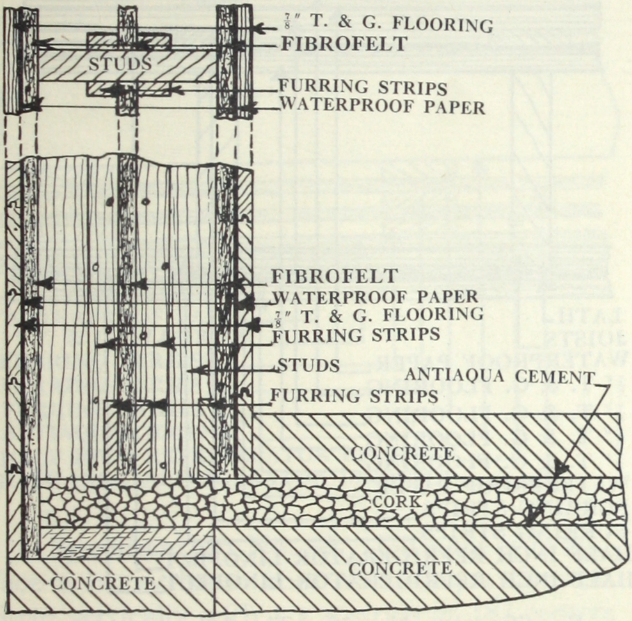
CEILING INSULATION: Frame Construction.

The following specification is suitable insulation for ceilings of ice storage houses or cold storage rooms of frame construction and shows proper manner of connecting insulation on walls and ceiling.



Specification No. 37. *On top of joists, lay one course of $\frac{7}{8}$" T & G flooring. Cover with water-proof paper, edges well lapped. Then lay five layers of $\frac{1}{2}$" Fibrofelt with water-proof paper between the layers. Cover top surface with water-proof paper and flood with Antiaqua Cement.*

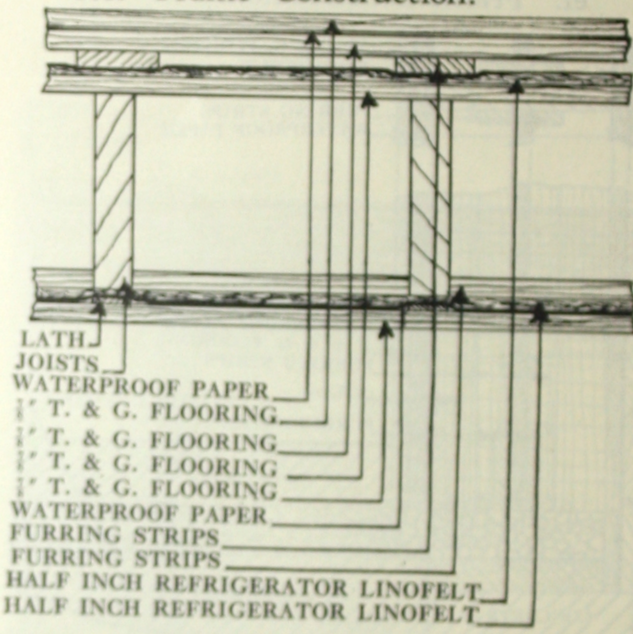
FLOOR INSULATION: To be applied on Concrete, Well Packed Cinders or Gravel. Frame Construction.



Specification No. 38. Lay down in hot Antiaqua Cement one thickness of 3″ Cork Board. Surface with a heavy coat of hot Antiaqua Cement ready for the concrete working floor. This construction is suitable for floors of ice storage buildings or cold storage buildings.

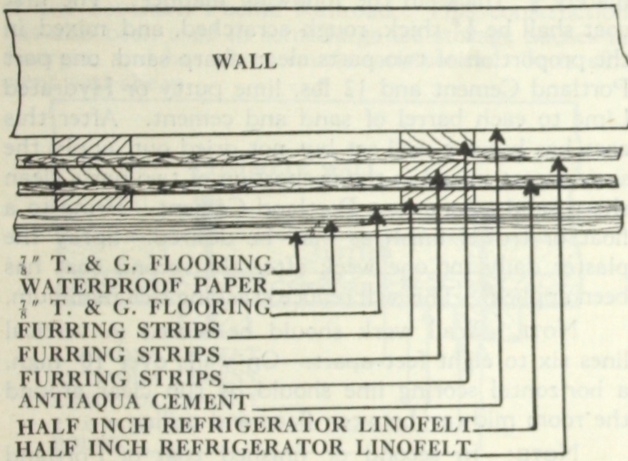
NOTE: The floor insulation should extend between wall studs flush with outer edge of studs. Where used with Linofelt or Fibrofelt, insulate walls as shown by sketches 35 or 36. The insulation on outside of the wall should extend down far enough to lap over the floor insulation in order to properly seal the joints at this point.

Light Insulation; FLOORS OR CEILINGS of Vegetable Cellar, Chocolate Room, etc. Frame Construction.



Specification No. 39. The following is recommended as being very desirable for chocolate rooms or other rooms where only a light insulation is desired. Lay directly on the floor boards on top of joists, one thickness of ½" Refrigerator Linofelt. Lay ⅞" x 4" furrings on top of Linofelt over the joists, finish with two layers ⅞" T & G flooring with water-proof paper between. Set 1" x 4" furrings between joists on under side at 36" centers. Apply one layer ½" Refrigerator Linofelt direct to base of joists. Cover with water-proof paper and fasten in place with lath nailed to joists. Finish with one layer ⅞" T & G flooring.

Light WALL INSULATION for Chocolate Room, Vegetable Cellar, etc. Brick or Tile Walls.



Specification No. 40. Give the wall surface a heavy brush coat of Antiaqua Cement. Strip vertically with 1 x 4 strips at 18″ centers and strip horizontally with 1 x 4 strips at 36″ centers. Apply on these furrings, one layer of ½″ Refrigerator Linofelt, then apply another layer of strips and another layer of Linofelt in as many thicknesses as may be desired. Finish with two layers of ⅞″ T & G boards with double water-proof paper between applied to the outer course of furring strips.

PORTLAND CEMENT PLASTER FINISH.

Specification No. A41. Apply to the insulated surface two coats of Portland Cement Plaster approximately ½″ thick, in the following manner: The first coat shall be ¼″ thick, rough scratched, and mixed in the proportion of two parts clean sharp sand, one part Portland Cement and 12 lbs. lime putty or Hydrated Lime to each barrel of sand and cement. After this coat has become well set but not dried out, apply the second coat mixed in the proportion of two parts clean sharp sand to one part Portland Cement. Bring to a float or trowel finish as may be desired. Spray the plaster daily for one week after the second coat has been applied. This will reduce cracking to a minimum.

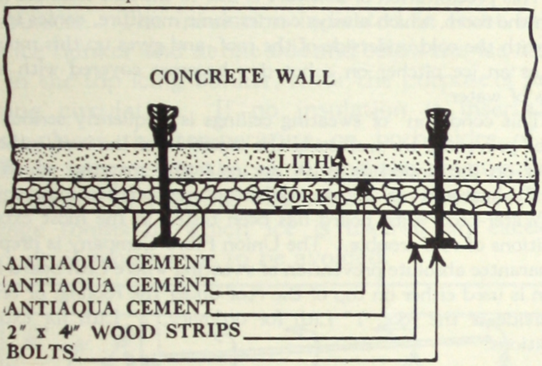
NOTE: Wall work should be scored in vertical lines six to eight feet apart. On walls over 10′ high, a horizontal scoring line should be run clear around the room midway between floor and ceiling.

NOTE: In second or finished coat of Portland Cement plaster, especially in rooms where much moisture is to be expected, it is advisable to specify some cement waterproofing of which there are several varieties in use.

NOTE: It is difficult to prevent small cracks or checks from appearing in Portland cement plaster because it contracts when it is setting. These cracks may be largely prevented by scoring, and in any event do not affect the efficiency of the insulation.

ICE STORAGE WALLS: Brick, Stone, Concrete, Hollow Tile or Frame.

The construction described below is that used in insulating the walls of the California precooling plants of the Southern Pacific Railroad. This construction has also been used in some large ice storage houses in Georgia, and has given much satisfaction. It is efficient and cheap.



Specification No. 42. Walls of brick or concrete are first carefully cleaned and a layer of Lith board (two inches or three inches in thickness according to exposure) is set up either in Portland cement plaster or in Antiaqua cement. Over the face of the Lith board a layer of two inch Cork Board is applied. either in Portland Cement plaster or in Antiaqua Cement. On twenty inch centers 2x4 vertical wood strips running from the floor to the ceiling, are bolted through the insulation to the wall. A heavy coat of Antiaqua Cement is applied on the face of the Cork Board and over the wood strips. No other finish is required.

If desired, horizontal wood strips may be nailed to the 2x4 upright strips. This improves the construction because the ice may be piled directly against these horizontal strips, and an air circulation down the wall provided for.

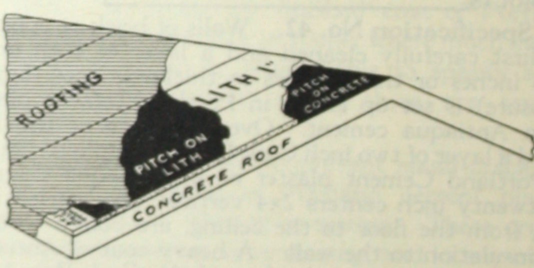
INSULATION OF ROOFS TO PREVENT CONDENSATION OF MOISTURE ON CEILINGS

All roofs made of concrete, and frequently roofs of wood, in the common phrase "sweat" in the winter time; in other words, the ceiling under the roof, when the room is warm, becomes covered with small drops of water. Sometimes this condition extends to the walls. Both roof and walls need treatment when sweating occurs.

This precipitation of moisture is due to the fact that the warm air in the room, which always carries some moisture, comes in contact with the cold underside of the roof, and gives up this moisture just as an ice pitcher on a hot day becomes covered with small drops of water.

This condition of sweating ceilings is frequently serious. It can be prevented by protecting the structure of the roof, either on top or on the underside, with an insulating material which will hold the heat and prevent the roof structure from becoming chilled.

Water-proof Lith board has been tested in the most extreme conditions of roof trouble. The Union Fibre Company is prepared to guarantee absolute prevention of sweating where Lith board insulation is used either on top of the roof under the roofing, or on the underside of the roof, 1" Lith for ordinary, 2" Lith for extreme conditions.

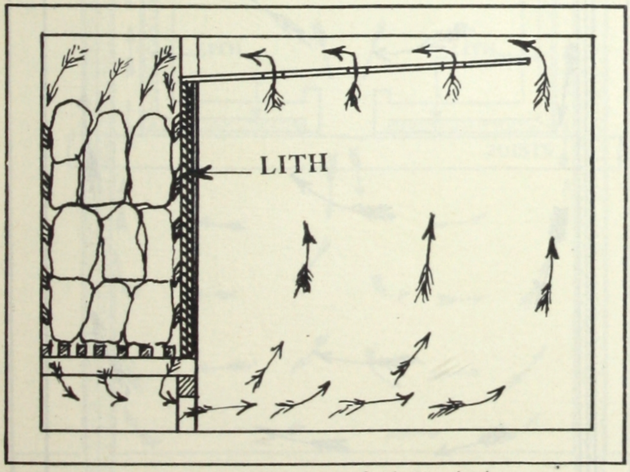


One Method of Applying Lith Boards for Roof Insulation

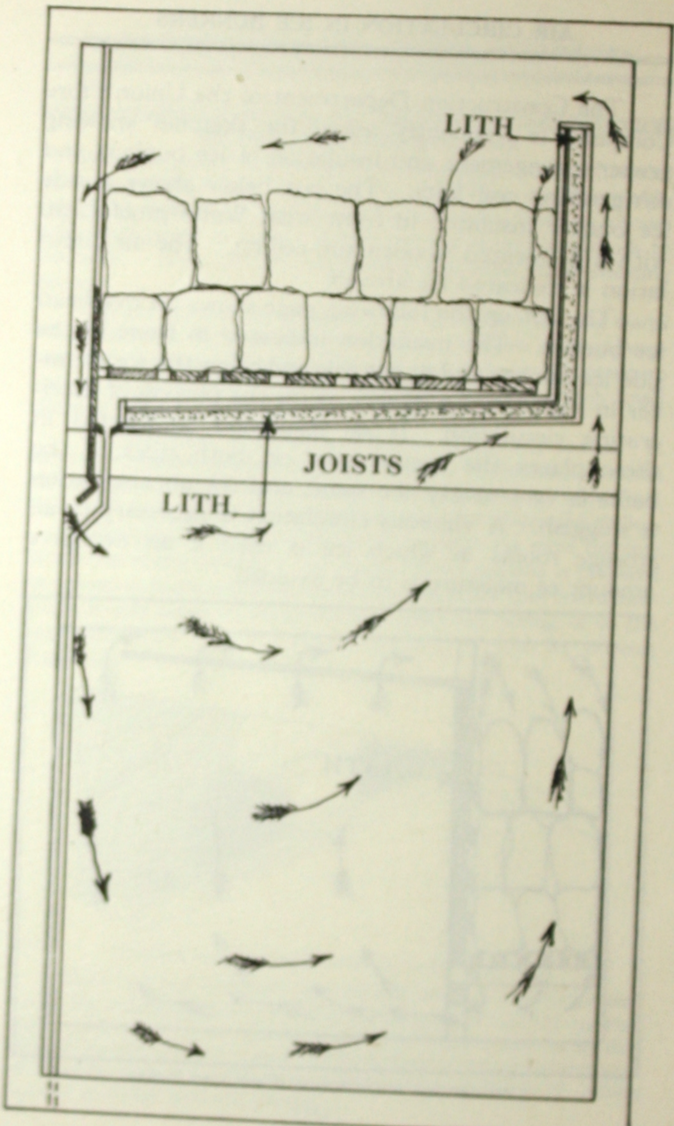
When the roof structure is wood and when it is inconvenient to lay the insulation on top of the roof, Refrigerator Linofelt one-half inch in thickness, covered with water-proof paper, may be applied directly on the timbers, then a 1x2 furring strip, then a second layer of Linofelt, then a second furring strip, then a finish of ceiling lumber or metal lath and plaster.

The Construction Department of the Union Fibre Company is frequently asked for sketches showing proper arrangement and insulation of ice bunkers and refrigerating coil lofts. The cut below shows a side ice bunker insulated in front with Water-proof Lith, with a perforated wooden sub-ceiling. The air circulation is indicated by arrows.

The cut on the following page shows an overhead ice bunker. The insulation indicated in front in the side ice bunker and at one side and below the ice chamber in the top icing bunker, is for the purpose of accelerating circulation. If no insulation is inserted in these places the temperature on both sides of the baffle is very nearly the same, and the air circulation is sluggish. A vigorous circulation is necessary in all storage rooms in which ice is used if an excessive amount of moisture is to be avoided.



Arrangement and insulation of side icing bunker

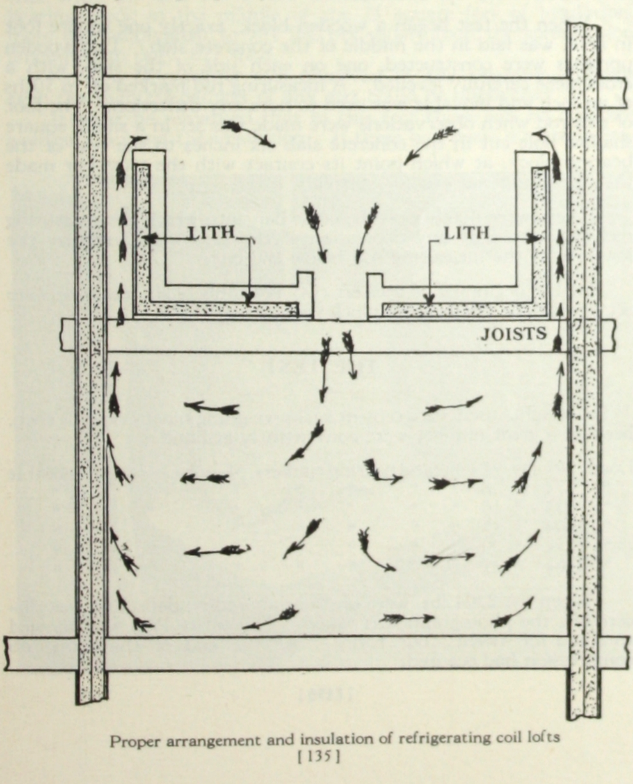


Arrangement and insulation of top icing bunker

The cut below indicates the proper arrangement of an excellent type of refrigerating coil loft. The refrigerating coils are installed in the spaces where the word "Lith" now appears. The coils rest on concrete floors. Underneath the concrete and on the sides of the uptake ducts there is Lith insulation.

The direction of the circulation is indicated by arrows: The cold air falls down at the center and being warmed rises at the sides to the loft where it is cooled and again falls at the cnter.

Insulation is necessary, as indicated in the discussion about ice bunkers, in order that the air circulation may be properly stimulated.



Proper arrangement and insulation of refrigerating coil lofts

We are frequently asked by architects for tests showing the compression of Water-proof Lith on floors under three inch concrete slabs. The following test was made in Chicago in September, 1911.

There were four layers of two inch Water-proof Lith five feet square, making in all twenty-five square feet. The Lith was laid as follows:

On top of a concrete base was laid a layer of two inch Lith bedded in hot asphalt, then followed a second layer of asphalt and a second layer of Lith, a third layer of asphalt and a third layer of Lith, a fourth layer of asphalt and a fourth layer of Lith. The top of the fourth layer of Lith was also covered with asphalt. On top of this, a 3½ inch thickness of concrete mixed 1, 3, 4½ was laid on the Lith, and a half inch smooth finish of one part Portland cement to two parts sand was then applied. This structure was allowed to harden for 35 days.

When the test began a wooden block, exactly one square foot in area, was laid in the middle of the concrete slab. Two wooden uprights were constructed, one on each side of the slab, with a cross piece carefully levelled. A measuring rod marked off in 50ths of an inch and movable was used to note any deflection. The foot of this rod when observations were made was set in a small square shallow hole cut in the concrete slab six inches to the rear of the bearing block, at which point its contact with the cross-bar made the measuring rod exactly vertical.

There were notches on the cross-bar, into which the measuring rod fitted, so that any depression of the slab was shown by the lowering of the measuring rod below the bar.

At the beginning of the test two 4x4 timbers six feet long were set on edge on the bearing block to carry the load.

THE TEST

The weights used were cement sacks weighing ninety pounds each, because a great number were conveniently at hand.

Load	504	lbs.	5	bags	and	bearing	timbers.	No	compression	noticeable
"	774	"	8	"	"	"	"	"	"	"
"	954	"	10	"	"	"	"	"	"	"
"	1404	"	15	"	"	"	"	"	"	"
"	1854	"	20	"	"	"	"	"	"	"
"	2304	"	25	"	"	"	"	"	"	"

When the 2304 lbs. were on the slab and no deflection was discernible, the photograph was taken. The entire load was allowed to stand for twenty-four hours. At the end of that time no compression had occured.

At this time the first load and the 4x4 timbers originally used were removed, and two 4x8 six foot long timbers were substituted on the bearing block to carry a heavier load of cement bags.

2802	lbs.	30	bags	and	bearing	timbers.	Compression	none
3252	"	35	"	"	"	"	"	none
3702	"	40	"	"	"	"	"	none
5502	"	60	"	"	"	"	"	.01 inch
7302	"	80	"	"	"	"	"	.015 "
9198	"	100	"	"	"	"	"	.02 "
12798	"	140	"	"	"	"	"	.02 "
14598	"	160	"	"	"	"	"	.025 "

After 80 bags had been piled on, the load was removed and two additional 4x8 timbers were set on top of the others at right angles to provide room for the increased number of cement bags.

Observations on Waterproof Lith Tests. It will be seen that with the last 14598 lbs. concentrated on the square foot bearing block in the middle of the 25 square feet of insulation, more than equivalent to 584 lbs. per square foot, the compression amounted to only .025 inch.

No sign of cracking was observed in the concrete and not even the slightest damage of any sort could be discovered.

It must be remarked that in this test there was no concrete wall built around the insulation. If there had been, a material im-

provement in the test would unquestionably have resulted as the concrete retaining wall would resist the slight squeezing out at the edges which undoubtedly accompanies a compression test such as above described.

In Boston in February 1909, Water-proof Lith was tested with a load of 1019 lbs. per square foot and showed a compression of only .031 inch with no damage whatever to the 3 inch concrete slab on top of it.

Waterproof Lith with 3 inches of concrete above it may be used with perfect satisfaction in all floors to support loads of 500 to 750 lbs. per square foot— greater loads are not carried in any insulated building.

COMPRESSION TEST OF UNION CORK BOARD.

At Winona, Minn., in June 1910 a compression test of two layers of 2 inch Union Cork Board, 4 inches in all, was made with 25 square feet of surface in the same manner as the Lith test above described. No compression was shown under a load of 25000 lbs. on this slab concentrated on a bearing block 1 foot square, or 1000 lbs. to the square foot over the entire 25 feet. This weight was left on the slab for one week without compression.

BOND OF PORTLAND CEMENT PLASTER AND WATER-PROOF LITH.

In August 1909 tests were conducted by the Union Fibre Company at Winona, Minn., to determine the strength of bond between Portland Cement and Water-proof Lith. A ceiling, formed of building tile, was carefully chipped and washed with hot water. Portland Cement mortar, mixed one part good Portland Cement to two parts of clean sharp sand, was spread one half inch thick on a Lith Board 3 inches thick, 18 inches wide and 24 inches long (3 square feet). An oak stick, 1 inch wide, 1 inch thick and 26 inches long, was partly imbedded in the Lith so as to be flush against the ceiling and to protrude 1 inch from each end of the Lith.

After the Lith was applied to the ceiling it was allowed to set for thirty days. At the end of that time weights were hung at each end of the Lith Board, attached to the oak strip. The Lith parted from the ceiling when 628 lbs. had been suspended. 318 lbs. at each end of the Lith Board. The rupture occurred in the Lith Board itself — there was left a film of Lith about ¼ inch thick, adhering to the plaster which had not been injured in any way.

BOND OF PORTLAND CEMENT PLASTER AND UNION CORK BOARD.

In May 1910 at Winona, Minn., a test was made by the Union Fibre Company to determine the strength of the bond between Union Cork Board and Portland Cement plaster. The test was conducted in exactly the same manner as that for Water-proof Lith, above described, the same ceiling (tile) was used and the same Portland Cement mortar. The Cork Board, however, was 3 inches

thick, 12 inches wide and 24 inches long (2 square feet). The Cork remained attached to the ceiling until 644 lbs. had been suspended from the oak strip embedded in the plaster between the cork and the ceiling. There were 322 lbs. suspended at each end of the Cork Board when the rupture occurred. After the rupture a number of the cork granules were left embedded in the cement mortar on the ceiling, but some of the mortar had given way and stuck to the fallen Cork Board.

NOTE.—No nails or any extraneous supports to the insulating boards were used. The endeavor was to find how much weight the mortar applied directly to the insulation, would support.

BOND OF PORTLAND CEMENT PLASTER TO ANTIAQUA CEMENT.

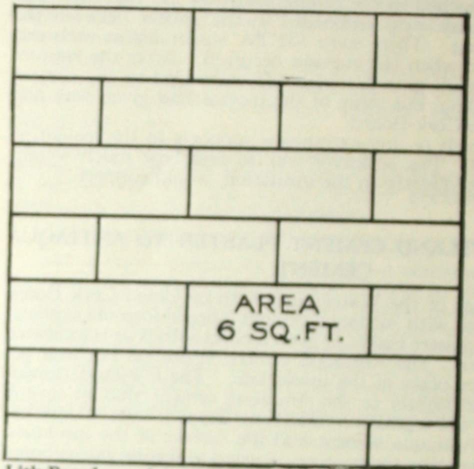
When the face of the Water-proof Lith or Union Cork Board insulation is coated with Antiaqua cement (special formula asphalt) Portland cement plaster makes as good a bond with it as is indicated in the above tests. The Antiaqua cement is put on hot and permeates the surface pores of the insulation. The Portland cement plaster adheres so tightly to the Antiaqua cement that in several instances where the insulation was torn down it was found that the plaster, the Antiaqua cement and the surface of the insulation adhered together so that the rupture occurred in the insulating board itself, a film of Lith or a film of cork board coming away with the plaster and Antiaqua cement in one mass.

ASPHALT VS. PORTLAND CEMENT IN THE ERECTION OF INSULATION.

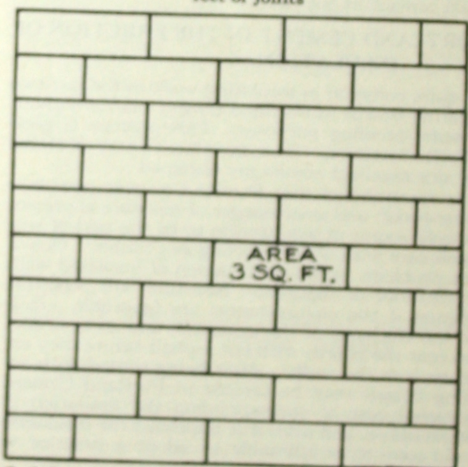
It has become quite common in insulating work in the last two years to erect insulating boards in Portland cement plaster without using asphalt for water-proofing purposes. This practice is good when it is followed with discretion. In many places where insulated rooms are perfectly dry excellent results are obtained.

But it must be remembered that Portland cement plaster is porous and not water-proof, and since danger of moisture is present quite frequently in cold rooms, it would seem to be the part of wisdom to take as much care with water-proofing as possible. One of the most important problems in the construction of insulated walls is to prevent the entrance of moisture. Moisture will penetrate any form of insulation if the circumstances are favorable. It is certainly an aid to the efficiency of the insulation and an insurance against moisture to coat the boards with hot asphalt before they are applied, as well as to coat the walls. After being coated with asphalt, the insulating boards may be erected in Portland Cement plaster. The additional cost of water-proofing the insulation in this manner is not excessive, and even if it improved the insulation only a little it would seem to be advisable to adopt a practice so clearly indicated by common sense.

THE JOINTS IN INSULATION



Lith Board covering 100 square feet of area; 80 lineal feet of joints



Cork Board covering 100 square feet of area; 120 lineal feet of joints

The efficiency of insulation when it is installed depends largely upon the proper sealing of joints, therefore large boards are a distinct advantage because they cover a larger area and consequently have a lesser number of joints.

These diagrams show the number of lineal feet of joints in a hundred sq. ft. of insulation. Waterproof Lith Boards cover six sq. ft. of area; ordinary cork boards cover three sq. ft. of area.